

論文 / 著書情報  
Article / Book Information

題目(和文)	
Title(English)	Study on the Influence of Interactive Learning Materials on Self-Regulated Learning for the Professional Development of Primary School Teachers in Mongolia
著者(和文)	Li Shengru
Author(English)	Shengru Li
出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第10966号, 授与年月日:2018年9月20日, 学位の種別:課程博士, 審査員:山口しのぶ,高田潤一,阿部直也,山下幸彦,花岡伸也
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第10966号, Conferred date:2018/9/20, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
Type(English)	Doctoral Thesis

Study on the Influence of Interactive Learning Materials on  
Self-Regulated Learning for the Professional Development of  
Primary School Teachers in Mongolia

By  
Shengru Li

Yamaguchi-Takada Laboratory

Submit in the partial fulfillment of the requirements for the degree of  
Doctor of Engineering  
in the Department of International Development Engineering  
Graduate School of Science and Engineering

Tokyo Institute of Technology

2018

## Table of Contents

List of Tables.....	6
Table of Figures.....	9
Abstract.....	11
Thesis Summary .....	12
Acknowledgement.....	16
Chapter 1: Introduction .....	17
1.1 Country background .....	17
1.2 Educational reforms in Mongolia .....	19
1.3 Relevance of the study.....	20
1.4 Research objectives .....	21
1.5 Significance of the study.....	22
1.6 Organization of thesis .....	22
Chapter 2 Literature Review .....	24
2.1 Self-regulated learning (SRL).....	24
2.1.1 Zimmerman’s self-regulated learning model .....	25
2.1.2 Pintrich’s self-regulated learning model .....	28
2.1.3 Learning outcomes in the context of self-regulated learning.....	31
2.1.4 SRL and in-service teacher training .....	34
2.1.5 SRL and in-service teacher training in Mongolian context.....	35
2.2 Interactive learning materials.....	35
2.2.1 Emergence of interactive learning materials.....	35
2.2.2 Types of interaction in interactive learning materials.....	36

2.3	SRL and interactive learning materials.....	37
2.3.1	Interactive learning materials and learning motivation .....	37
2.3.2	Interactive learning materials with cognitive and metacognitive strategies .....	39
2.3.3	Interactive learning materials and resource management strategies ....	42
Chapter 3 Development of interactive materials.....		44
3.1	Motivation behind the development of interactive materials .....	44
3.2	Initial consultation .....	45
3.3	Tool selection .....	45
3.4	Content development .....	47
3.4.1	Development of quizzes and interactive materials.....	47
3.4.2	Verification of interactive materials by educational experts.....	48
3.4.3	Finalization .....	48
Chapter 4: Methodology .....		50
4.1	Theoretical framework .....	50
4.2	Study design .....	51
4.3	Instrument .....	53
4.3.1	Selection of the instruments .....	53
4.3.2	Localization of the instrument.....	53
4.4	Data collection.....	54
4.4.1	Quantitative data collection .....	54
4.4.2	Qualitative data collection.....	55
4.5	Preparatory analysis and research framework.....	55

4.5.1	Step 1: Reliability analysis of theoretical components.....	55
4.5.2	Step 2: Exploratory factor analysis (EFA).....	58
4.5.3	Step 3: Create latent variables by summing and averaging.....	62
4.6	Research questions and hypothesis.....	66
4.6.1	Overview.....	66
4.6.2	Research questions.....	67
4.6.3	Hypotheses.....	68
4.7	Data analysis procedure.....	69
4.7.1	Multiple linear regression analysis.....	69
4.7.2	T-test and Wilcoxon rank-sum test (Mann-Whitney U-test).....	71
4.7.3	Moderated multiple linear regression.....	74
Chapter 5: Data analysis.....		82
5.1	Descriptive analysis.....	82
5.2	RQ1: Result of multiple linear regression analysis.....	84
5.2.1	Assumptions of the model for RQ1.....	86
5.3	RQ2: Results of t-test and Man-Whitney U-test.....	90
5.3.1	Descriptive analysis.....	90
5.3.2	T-test result.....	91
5.3.3	Man-Whitney U-test result.....	95
5.4	RQ3: Result of moderated multiple linear regression.....	98
5.4.1	RQ3: Result of model 3.1.....	100
5.4.2	RQ3: Result of model 3.2.....	102
5.4.3	RQ3: Result of model 3.3.....	105

5.4.4	RQ3: Result of model 3.4.....	107
5.4.5	RQ3: Result of model 3.5.....	109
5.4.6	Hypotheses testing results for RQ3 .....	111
Chapter 6: Discussion .....		113
6.1	Research question 1 .....	113
6.1.1	Internal motivation affects learning satisfaction and intention to apply learning contents .....	113
6.1.2	Planning and organizing skill affects learning satisfaction and intention to apply learning contents .....	114
6.1.3	Critical and positive thinking skill affects learning satisfaction and intention to apply learning contents .....	115
6.2	Research question 2 .....	116
6.2.1	Hypotheses testing for research question 2 .....	116
6.2.2	Teachers using interactive materials perceive higher motivation for better assessment .....	117
6.2.3	Teachers using interactive materials perceive higher learning satisfaction and intention to apply learning contents .....	118
6.3	Research question 3 .....	119
6.3.1	Hypotheses testing for research question 3 .....	120
6.3.2	The use of interactive materials positively affects the relationship between internal motivation and learning satisfaction and intention to apply learning contents. ....	121
6.3.3	The use of interactive materials positively affects the relationship between motivation for better assessment and learning satisfaction and intention to apply learning contents. ....	121

6.4	Denied hypotheses for research question 2 and 3.....	122
Chapter 7: Conclusion .....		125
7.1	Research context and objectives.....	125
7.2	Important findings .....	126
7.3	Implications.....	128
7.4	Limitations and further research.....	129
7.5	Final conclusion.....	130
References.....		132
Appendix 1: Screenshots of interactive materials.....		147
Appendix 2: The survey questionnaire applied in this study .....		151
Appendix 3: Rotated component matrix of exploratory factor analysis – 1.....		159
Appendix 4: Rotated component matrix of exploratory factor analysis – 2.....		162
Appendix 5: Descriptive statistics and histograms of the constructing items for latent variables .....		164
Appendix 6: Qualitative data collected from focus group discussion and interviews with local primary school teachers in Bayankhongor .....		175

## List of Tables

Table 2-1: Analyzing relationships between interactive learning materials and learning motivation .....	39
Table 2-2: Analyzing relationships between interactive learning materials and cognitive plus metacognitive strategies .....	41
Table 2-3: Analyzing relationships between interactive learning materials and resource management processes .....	43
Table 3-1: Comparative analysis for selecting authoring tool .....	47
Table 3-2: Summary of types and number of quizzes in interactive teacher training material.....	49
Table 4-1: List of schools and number of teachers participating this study.....	52
Table 4-2: Summary of focus group discussion and interview.....	55
Table 4-3: Reliability analysis of all theoretical components .....	56
Table 4-4: Theoretical components retained based on reliability analysis .....	57
Table 4-5: Constructing items for latent variables and its naming .....	61
Table 4-6: Reliability analysis of latent variables .....	65
Table 4-7: Overview of research questions, test method, and hypotheses .....	66
Table 5-1: Regression coefficients and collinearity statistics for RQ1 .....	85
Table 5-2: Model Summary <sup>b</sup> for RQ1.....	86
Table 5-3: ANOVA <sup>a</sup> for RQ1 .....	86
Table 5-4: Descriptive statistics for RQ2 .....	91
Table 5-5: Hypothesis testing result using t-test for RQ2.....	93
Table 5-6: Independent samples t-test result for RQ2.....	94
Table 5-7: Hypothesis testing result using Mann-Whitney U-test for RQ2.....	97

Table 5-8: Models of moderated multiple linear regression for RQ3 .....	99
Table 5-9: Coefficients <sup>a</sup> of Model 3.1 .....	100
Table 5-10: Model 3.1 Summary .....	101
Table 5-11: ANOVA <sup>a</sup> for Model 3.1 .....	102
Table 5-12: Coefficients <sup>a</sup> for Model 3.2 .....	103
Table 5-13: Model 3.2 Summary .....	104
Table 5-14: ANOVA <sup>a</sup> for Model 3.2 .....	105
Table 5-15: Coefficients <sup>a</sup> for Model 3.3 .....	106
Table 5-16: Model 3.3 Summary .....	106
Table 5-17: ANOVA <sup>a</sup> for Model 3.3 .....	107
Table 5-18: Coefficients <sup>a</sup> for Model 3.4 .....	108
Table 5-19: Model 3.4 Summary .....	108
Table 5-20: ANOVA <sup>a</sup> for Model 3.4 .....	109
Table 5-21: Coefficients <sup>a</sup> for Model 3.5 .....	110
Table 5-22: Model 3.5 Summary .....	110
Table 5-23: ANOVA <sup>a</sup> for Model 3.5 .....	111
Table 5-24: Hypotheses testing results for RQ3 .....	112
Table 13-1: Descriptive statistics of the constructing items for internal motivation .....	164
Table 13-2: Descriptive statistics of the constructing items for learning satisfaction and intention to apply learning contents .....	167
Table 13-3: Descriptive statistics of the constructing items for planning and organizing skills.....	169

Table 13-4: Descriptive statistics of the constructing items for critical and positive thinking skills .....	171
Table 13-5: Descriptive statistics of the constructing items for motivation for better assessment .....	173
Table 13-6: Descriptive statistics of the constructing items for effort regulation ...	174

## Table of Figures

Figure 1-1: Administrative map of Mongolia (Vorel, 2014) .....	17
Figure 1-2: Percentages of population with access to electricity (World Bank, 2018) .....	19
Figure 2-1: Zimmerman's self-regulation model .....	25
Figure 4-1: Theoretical framework .....	50
Figure 4-2: Map showing the location of schools participating the study.....	52
Figure 4-3: Research framework for RQ1 .....	67
Figure 4-4: Conceptual model of moderation analysis.....	74
Figure 4-5: Statistical model for moderation analysis .....	75
Figure 4-6: Visual representation of coefficients in moderation model .....	77
Figure 4-7: Conceptual diagram for the moderation of negative emotions about climate change on support for government action by age with various covariates.....	78
Figure 4-8: Statistical diagram for the moderation of negative emotions about climate change on support for government action by age with various covariates.....	78
Figure 4-9: Conceptual diagram of moderation with 2 moderators .....	79
Figure 4-10: Statistical diagram of moderation with 2 moderators .....	79
Figure 5-1: Gender .....	82
Figure 5-2: Location of your school.....	82
Figure 5-3: Years of service as teacher .....	82
Figure 5-4: Age.....	82
Figure 5-5: How often teachers use interactive materials .....	83

Figure 5-6: Plot of residual to predicted value for the model of RQ1 .....	87
Figure 5-7: Plot of learning satisfaction to motivation for better assessment for RQ1 .....	87
Figure 5-8: Plot of learning satisfaction to internal motivation for RQ1 .....	87
Figure 5-9: Plot of learning satisfaction to planning and organizing skills for RQ1	88
Figure 5-10: Plot of learning satisfaction to critical and positive thinking skills for RQ1 .....	88
Figure 5-11: Plot of learning satisfaction to effort regulation for RQ1 .....	88
Figure 5-12: Normal P-P plot of regression standardized residual for the model of RQ1 .....	89
Figure 5-13: Histogram of regression standardized residual for the model of RQ1.	89
Figure 5-14: Independent samples U-test for learning satisfaction and intention to apply learning contents .....	95
Figure 5-15: Independent samples U-test for motivation for better assessment .....	96

## Abstract

Given the importance of professional development in Mongolian primary education, the purpose of this study is: 1) to identify important self-regulation processes that affect teachers' learning outcome, and 2) to find out the influence of interactive materials on teachers' learning in self-development. Data were collected from 285 primary school teachers in two groups, those who utilized interactive training materials and those who did not. Data analysis was carried out in three steps. First, multiple linear regression analysis showed that among five factors, internal motivation, planning and organizing skills, and critical and positive thinking skills are positively affecting learning satisfaction. Second, t-test revealed that motivation for better assessment and learning satisfaction are higher for teachers utilizing interactive materials. Third, moderation analysis demonstrated that the influences of internal motivation and motivation for better assessment on learning satisfaction are stronger for teachers utilizing interactive materials.

# Thesis Summary

## Chapter 1: Introduction

This chapter reviews the global and Mongolian national trend in education, specifically regarding policies and project implementations on teachers' development to promote quality education. This study aims to 1) identify important self-regulated learning processes that affect teachers' learning outcome, and 2) find out the influence of interactive materials on teachers' learning in self-development based on self-regulated learning (SRL) theory.

## Chapter 2: Literature review

### 2.1 Self-regulated learning theory

Self-regulated learning theory explains the process of planning and cyclically adapting self-generated thoughts, feelings, and actions to influence one's learning outcome. Self-regulation processes comprise motivation and learning strategies. While motivation refers to various motivational beliefs such as goal orientation (purpose of doing a task) and self-efficacy, learning strategies contain cognitive strategies, metacognitive strategies, and resource management strategies. Cognitive strategies refer to mental operations, procedures and processes that the learner engage in to acquire, integrate, organize, and retain new information.

Metacognitive strategies refer to specific processes by which the learner evaluates or monitor their own thinking and knowledge structures, such as setting goals and self-monitoring. Finally, resource management strategies refer to learners' behaviors regarding changing tasks and learning conditions. Therefore, self-regulated learning is concerned with how learners activate and sustain their motivation and learning strategies to attain the learning objectives, hence influencing one's learning outcome. Among different types of learning outcome, this study looks at learning satisfaction as a learning outcome, supported by Zimmerman (2000).

### 2.2 Self-regulated learning and interactive materials

Self-regulated learning theory is used to understand the effectiveness of interactive materials in facilitating self-learning since the interactive materials have characteristics to promote learning motivation and learning strategies. For example, menu and navigational contents with summary of information could support the use of metacognitive skills, such as planning the learning activities. Interactive materials also have the feature to provide timely feedback to the learners, which elevates learner's belief that their learning efforts can lead to positive learning outcomes.

### Chapter 3: Development of interactive materials

The interactive materials were developed using the authoring tool "Xerte" in cooperation with Mongolian professionals in three teacher training subjects: Man and Environment, Man and Society and Art and Technology. Teacher training guidelines and videos were utilized to develop learning contents in quiz format and were converted into the interactive materials. There are 107 quizzes in total combining different types of quizzes including true and false questions, multiple-choice questions, fill in the blank, and ordering sequences. The interactive materials were locally verified and revised based on inputs from the local educational experts and translated into Mongolian language for distribution.

### Chapter 4: Methodology

#### 4.1 Study design and data collection

This study employs the two-group experimental design where experimental and control group were formulated in the Gobi Region of Mongolia, involving 285 primary school teachers. Experimental group teachers utilized interactive materials, teacher training video and guideline for self-development while the control group teachers did not utilize interactive materials. Data collection took place 6 months after teachers utilized interactive materials, using the localized Motivated Strategies for Learning Outcome questionnaire (Pintrich et al., 1991) and the learning outcome questionnaire (Pintz et al., 2013, Zhao et al., 2009).

#### 4.2 Preparatory data analysis

Exploratory factor analysis and reliability analysis were applied on the data collected from two groups of teachers. Six latent variables were created. Five variables correspond with SRL processes: 1) internal motivation, 2) motivation for better assessment, 3) planning and organizing skills, 4) critical and positive thinking skills, and 5) effort regulation. One variable, learning satisfaction and intention to apply learning contents, correspond with learning outcome.

#### 4.3 Research questions

The study has formulated three research questions: 1) What are the factors among internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, and effort regulation that affect learning satisfaction and intention to apply learning contents? 2) Are there any differences in internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, effort regulation, and learning satisfaction and intention to apply learning contents between those who used interactive teacher training materials and those who do not? and 3) Does the use of interactive materials affect the relationship between learning satisfaction and intention to apply learning contents with internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, as well as effort regulation?

#### Chapter 5: Data analysis

Multiple linear regression analysis is used to answer research question 1. Among the five factors, three factors are found to affect learning satisfaction, namely, internal motivation, planning and organizing skills, and critical and positive thinking skills. These three factors explain 53% of the variance in teachers' learning satisfaction and intention to apply learning contents. In answering research question 2, t-test was utilized and found that teachers using interactive learning materials had statistically significantly higher level of motivation for better assessment and learning satisfaction. Moderation analysis is used to answer research question 3. Two significant models indicate: 1) the internal motivation has stronger influence on learning satisfaction for teachers using interactive materials,

and 2) the motivation for better assessment has stronger influence on learning satisfaction for teachers using interactive materials.

#### Chapter 6: Discussion

This chapter discusses the study result with the discussion in the current literature and qualitative data collected in the field. This study result agrees with the discussion in the current literature in the following three areas. First, learning motivation and the use of learning strategies are significant in promoting learning satisfaction for teachers' professional development. Second, interactive materials are beneficial in promoting learning motivation and learning outcome. Third, interactive materials moderate the relationship between learning motivation and learning outcome. Interviews and focus group discussions with local teachers and educational experts provided details and examples that could interpret how self-regulation processes affect learning satisfaction and the role of interactive materials in teachers' self-development.

#### Chapter 7: Conclusion

This chapter first summarizes the study context and research objectives. Following that, the important findings are reviewed. Finally, the research and practical implications, as well as limitations and further research are discussed. This study provides insights on self-regulated learning in ICT enabled distance learning context and the findings are of value in designing effective interactive materials for educational practitioners.

## Acknowledgement

Foremost, I would like to express my sincere gratitude to my advisor Professor Shinobu Yamaguchi and Professor Jun-ichi Takada for the continuous support of my Ph.D study and research, for her patience, motivation, enthusiasm, and immense knowledge. Her guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my Ph.D study.

Besides my advisors, I would like to thank my thesis committee: Prof. Naoya Abe, Prof. Shinya Hanaoka, and Prof. Yukihiko Yamashita for their insightful comments and encouragement, but also for the hard questions which incited me to widen my research from various perspectives.

Further, I would like to express my sincere gratitude for Professor Javzan Sukhbaatar and Professor Baterdene Regsuren for providing me special advice and accommodating the successful study in Mongolian education sector. I also appreciate very much the professors at Mongolian National University of Education and teachers of Bayankhongor province. Special thanks go to Ms. Dolgorsuren and Mr. Jamba for the support and assistance in conducting the teacher training and the study in Bayankhongor. I would also like to thank Ms. Orgilmaa and Professor Jadambaa for the courage and support for me to conduct this study. Last but not least, I would like to appreciate the support from Mr. Tsolmon from Ministry of Education, Culture, Science and Sports for providing local policy information. Without their precious support it would be impossible to conduct this research.

I thank my fellow laboratory members for the stimulating discussions and fun we have had in the past five years. Also, I thank the government of Japan in offering the scholarship which provided precious experience for me to pursue study and live in this beautiful country.

I always appreciate the patience, understanding and support from my parents Liren Li and Xingmei Feng for my study in Japan. I would also like to thank my close friends Juan Xu and Zhenhui Jun for their kindness and support in my study.

# Chapter 1: Introduction

This chapter covers the country background of Mongolia where the study took place. Then covers the educational reform in Mongolia, relevance of the study and the research objectives. Significance of the study followed by the organization of the thesis are also described.

## 1.1 Country background

Mongolia is a landlocked country situated between Russia and China. Mongolia is one of the world's most sparsely populated country with approximately 1.6 million km<sup>2</sup> land size and 3 million population (UNDP, 2013). The country size is approximately four times as big as Japan (0.37 million km<sup>2</sup>), and is rich with natural resources such as forests, fish and a variety of natural minerals.

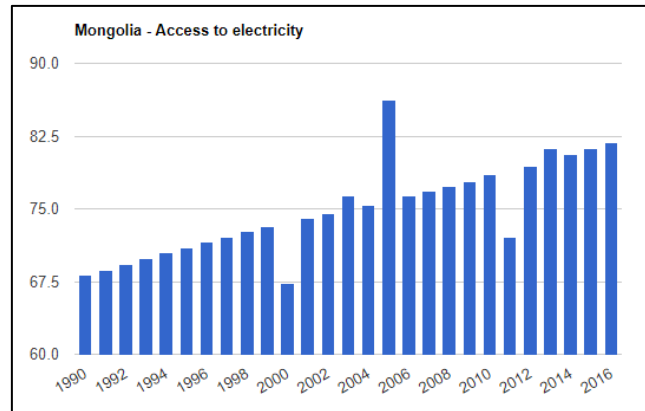


Figure 1-1: Administrative map of Mongolia (Vorel, 2014)

Administratively, Mongolia is divided into twenty-one provinces (aimags), and the aimags are divided into villages (soums). Villages are further divided into bags, which are the smallest administrative unit in Mongolia.

During 1990s, Mongolia experienced the relatively peaceful democratic revolution with the dissolution of Soviet Union (UNDP in Mongolia, 2013). The country has a multi-party system with a new constitution from 1992 and the transition to market economy. This has led to many changes in people's lives, and the history in the past two decades has proved that the country achieved rapid and successful transition to the democratic system (Pomfret, 1999). The Human Development Index (HDI) for Mongolia witnessed a steady increase from 0.55 in 1990 to 0.74 in 2015, which is ranked 92 out of 188 countries compared (UNDP, 2016). In more detail, Mongolia has made significant progress in reducing poverty, improving education, promoting gender equality and other aspects in socio-economic development. For instance, Mongolia has reduced the proportion of population living in poverty from 36.3% in 1990 to 18.3% in 2013 (UNDP, 2014), and to 11.1% in 2016 (UNDP, 2016). The country has also almost achieved universal primary education with the literacy rate at 99% in 2013 (UNESCO Institute for Statistics, 2014).

Electricity access is essential to the utilization of ICT in education on all levels. Mongolia has steady improvements over the past 25 years. It can be seen from Figure 1-2 that the access to electricity in Mongolia is over 81% in 2016, while world average is at 86% (World Bank, 2018). Policy implementations contribute to this trend, for example, ICT Vision 2010 lays out specific targets and resources to connect all schools with electricity by 2015. Further, the field visit of the author to both provincial center and village schools in Bayankhongor Province in 2016 and 2017 confirmed the electricity access at all schools visited. In particular, the field visit covers 13 schools from the north part to the south part of the province, and also includes provincial center schools and the most remote schools.



**Figure 1-2: Percentages of population with access to electricity (World Bank, 2018)**

## 1.2 Educational reforms in Mongolia

The Mongolian education system has experienced a major transition from a centrally planned system to a decentralized system since the 1990s. It resulted in the increased roles and responsibilities for local governments and schools. With such major changes, school managers and teachers in rural schools have faced difficulties. The specific issues include a lack of quality teacher training, limited budget, and gaps in education quality between rural and urban schools (UNDP, 2013). In order to address the need for change in public schools in Mongolia, the government has allocated funds through policy implementations, especially for rural schools. As a result of the basic infrastructure reaching every province of Mongolia, recent policies are focusing on the introduction of ICT into locally contextualized teacher training programmes for the quality improvement of rural education. For example, Education Master Plan 2006 (referred as “master plan” below) and ICT Vision 2021 in education emphasized the use of ICT for teacher development (Government of Mongolia, 2006; Information Communications Technology and Post Authority of Mongolia, 2011). Master Plan (2006) has specifically prioritized the ICT related policy in education aiming to connect all educational institutions, schools and kindergartens to Internet. It also promotes in introducing ICT into training, information exchange as well as monitoring. It is particularly emphasizing the use of ICT in rural schools for organization of training and new ICT tools and programs at school level contribute in quality standards for primary and secondary education. After the legislative document ICT Vision – 2010

was approved by Parliament of Mongolia, ICT Vision-2010 in Education Sector was approved by Ministry of Education, Culture, Science and Sports (MECSS) which lays out specific objectives, targets and resources to support schools. Further, the Policy of ICT in the Education Sector (2012 - 2016) formulated the policy to improve the continuous professional development of teachers through national teacher training platform (MECSS, 2012). More recently, ICT in Education Policy Action Plan (2012 - 2016) specified the plans to renew teacher training programs in accordance with latest ICT development as well as new education standards and curriculums (MECSS, 2012a). As a practical response to these initiatives, the MECSS of Mongolia established the web-portal for promoting the utilization of electronic and interactive learning contents since 2015 (MECSS, 2015).

### 1.3 Relevance of the study

With policy incentives encouraging teachers' professional development, school-based training has become an important strategy to raise educational standards with such a dispersed population. Decentralization of educational management gave the responsibilities of teachers' professional development to local governments. Local governments are active in implementing new approaches for teachers' professional development through integrating ICT (Tokyo Institute of Technology, 2012). In the past decade, digitized teacher training materials such as teacher training videos were being adopted and produced by the local educational practitioners. Tokyo Institute of Technology has been involved in the policy implementation of ICT in education since 2004. The previous project activities include the need assessment of ICT for teacher training, development of teacher training materials using open source software programs as well as video CD and guideline development. The author's previous research was conducted in Mongolia to understand the factors affecting teachers' perception on use of ICT for student-centered education. The study found that three factors affect teachers' perception on use of ICT for student-centered education, namely, professional competency, perceived benefits on use of ICT, and teacher cooperation.

Along with the rapid development of ICT integration in education, Tokyo Institute of Technology has been collaborating with Japan International Cooperation Agency (JICA) in implementing the project “Sustainable use of ICT for improving the quality of primary education in rural Mongolia”. The project aims at enhancing primary school teachers’ skills and competencies in their classroom teaching by effectively applying locally produced ICT-based teacher development material. During the course of the project implementation, the author has observed the active self-development of teachers maximizing the resources available at schools and local community level. Given that the schools are widely dispersed and centralized teacher training was not feasible, new method to promote and motivate teachers to improve their teaching quality has become an urgent demand.

Teachers conducting self-learning in distance learning context often face the need to self-direct their learning mainly due to the absence of instructors or peers to keep the learning on track. As ICT has become more common and a potential tool in professional development worldwide, the studies based on self-regulated learning have been popularly employed in many sectors including education. Self-regulation processes touches upon learning motivation, leaning behaviors, and cognition skills to achieve the learning goal (Pintrich, 2000). In education sector, it has been examining traditional classroom learning environments but it expanded its scope to online learning, and computer-mediated learning (Hwang & Vrongistinos, 2002; Kuo, Walker, Schroder, & Belland, 2014; Young, 1996; Zimmerman, 1990). Given that teachers in Mongolia are required to continuously engage in professional development, it is relevant to apply self-regulated learning theory to review the teacher training and to investigate the influence of interactive teacher training materials for their self-development. Specifically, the interactive materials for teacher development were designed, created and utilized in teacher training programs in Mongolia.

#### 1.4 Research objectives

Reflecting the relevance of the study, this study aims at reviewing the Mongolian primary school teachers’ professional development using self-regulated learning

theory and finding out the influence of interactive materials for teachers' self-development in teacher training. Research objectives include:

- 1) Identify important self-regulation processes that affect teachers' learning outcome; and
- 2) Find out the influence of interactive materials on teachers' learning in self-development based on self-regulated learning (SRL) theory.

### 1.5 Significance of the study

There are three major significances to conduct this research. First, the study result provides research implications by being one of the few studies in applying self-regulated learning theory for in-service teacher training using ICT in a developing country's context. This will offer information of self-regulated learning in an ICT-enabled, distance learning context for adult learners, whereas the majority of previous studies had focused on student learning in classrooms.

Second, the findings of the study provide empirical evidence in demonstrating the effectiveness of interactive materials. Through a quantitative and qualitative approach, this study links specific features within interactive materials in relation to its influences on learner's learning motivation, learning behaviors, and cognitive skills. This focus reflects suggestions from previous studies that how interactive learning materials affect learner's motivation and learning behaviors should be investigated.

Third, the findings of the study will serve as importance evidences in formulating policies for educational practitioners to implement interactive learning materials for professional development. This is particularly important when the use of ICT for teacher's professional development receives global attention from international development agencies such as UNESCO (UNESCO, 2018).

### 1.6 Organization of thesis

Chapter 1 – Introduction: this chapter presents the background of the research, relevance of the study, research objectives and significance of the study.

Chapter 2 – Literature review: this chapter first reviews two major self-regulated learning models. After that, learning outcome is discussed in detail, following by the discussion on the relationship between self-regulated learning and teacher training. Then, interactive learning materials and its relationship with self-regulated learning are explained.

Chapter 3 – Development of interactive materials: this chapter describes the identification of the tool to develop interactive materials, and the details in the development process for creating interactive materials for teacher training of Mongolian primary school teachers.

Chapter 4 – Methodology: this chapter begins with the development of theoretical framework based on the literature review in Chapter 2. Study design is described followed by the development of survey instrument tool. After that, data collection and the preliminary analysis on the data collected are described. The preparatory analysis result is utilized to form the research framework, research question and hypotheses. Finally, the data analysis methods are laid out.

Chapter 5 – Data analysis: this chapter reports the findings from data analysis. Respondent's demographics, the answers for research questions and hypotheses testing are included.

Chapter 6 – Discussion: this chapter discusses the major findings from data analysis results in correspondence with the relevant bodies of literature. Field interviews and group discussion results are utilized to supplement the quantitative data analysis results.

Chapter 7 – Conclusion: this chapter recaps the study background, research objectives and the important theories. Three important findings and implications are outlined to demonstrate the major outcomes of this research.

## Chapter 2 Literature Review

This chapter consists three major sections. The first section discusses the self-regulated learning theory with two major self-regulated learning models, and then moving onto a discussion on the learning outcome within the self-regulated learning framework. Following that, the relationship between self-regulated learning and in-service teacher training is discussed. Second section discusses the evolution of interactive learning materials and the definition of interactivity, especially in educational context. The third section introduces the relationship between self-regulated learning and interactive learning materials.

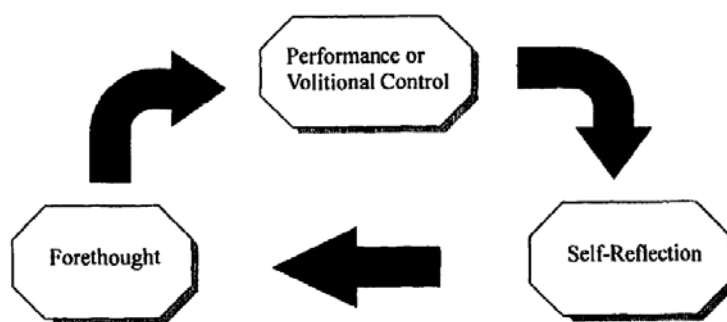
### 2.1 Self-regulated learning (SRL)

The research on self-regulation has its historical background. In 1950s and 60s, behaviorism was in dominant position in psychological research, but this approach was not found to be well suited in explaining human behavior. With this background, new theories focusing on reasoning of mind, problem solving, and motivation started to emerge in 1970s. This resulted a revolution in psychological research to focus on human memory, perception, and cognitive processes in general. In the late 1970s, the concept of metacognition started to appear, which refers to one's planning on the use of knowledge and skills in responding to different conditions. From here, psychologists started to argue that, in order for one to plan the use of knowledge and skills, one needs to consider their goals. That was the point when motivational research and the concept of "self" started to blend into the cognitive research. With such background, self-regulation becomes the one that integrate strands of cognitive, motivational, social, and behavioral theories. Self-regulated learning, in particular, is a specific branch of research that mainly deals with one's motivation and cognition in learning. Self-regulated learning was extensively researched since 1990s and there are two major conceptualizations of self-regulated learning. Zimmerman defines SRL as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (Barry J. Zimmerman, 2000, p. 19). While Pintrich views SRL as "an active, constructive process whereby learners set goals for their learning and

then attempt to monitor, regulate and control their cognition, intentions and behavior, guided and constrained by their goals and the contextual features of the environment” (Pintrich, 2000, p. 453). Self-regulated learning is not a mental ability or an academic performance skill, it is concerned about learner’s self-directive processes to transform their mental abilities into academic skills (Zimmerman, 2002). Learners who are self-regulated view learning as an activity for themselves and approach learning proactively.

### 2.1.1 Zimmerman’s self-regulated learning model

The first model of self-regulated learning is Zimmerman’s three-phases model which conceptualizes self-regulation into three cyclical phases (see Figure 2-1).



**Figure 2-1: Zimmerman's self-regulation model**

Source: “Self-regulated learning: From Teaching to Self-Reflective Practice”, p.3, by D. H. Schunk and B. J. Zimmerman (Eds.), 1998, New York: Guilford.

In his model, self-regulation happens in the following sequence: forethought, performance or volitional control, and self-reflection. In this paragraph, brief descriptions are given to these phases followed by discussion on specific processes of each phase. Forethought refers to the influential processes that comes before efforts of acting. Performance or volitional control involves efforts to act towards the objective. Self-reflection is a person’s response to the performance efforts he makes.

Specifically, forethought includes two categories: 1) task analysis and 2) self-motivational beliefs. Goal setting is an important aspect of task analysis. Goal setting means deciding specific learning outcomes or performance outcomes. The second aspect of task analysis is strategic planning, which refers to the planning of

actions in acquiring skills. For example, the effectiveness of initial knowledge acquisition skills may decline with the development of the learner's skills, at which point a new strategy will be necessary. The second category, self-motivational beliefs are considerably important for learner to carry out self-regulation skills such as goal setting introduced before. Therefore, Zimmerman states three motivational beliefs underlying tasks analysis: self-efficacy, outcome expectations, and goal orientations. Self-efficacy refers to personal beliefs about having the ability to perform well. Outcome expectations refers to the ends of performing well. For example, self-efficacy could be a learner's belief that one can get 90% correct answers from an exam while outcome expectation could mean one's belief that performance could lead one to a job that one desires. Zimmerman links goal orientations to self-efficacy beliefs. According to Bandura and Cervone's (1986) research, when learner is not fulfilling one's learning goal, the one with self-efficacy will increase the effort while the self-doubting one will withdraw from making more effort. This shows that different types of learning goals are associated with the level of self-efficacy. The learners who adopted process goals feel self-efficacious because their progressive goals in part provide them with immediate satisfaction rather than requiring them to suspend any sense of success until the final outcome goals is attained. Previous evidence shows that process goals can become intrinsically motivating on its own right (Schunk & Swartz, 1993; Barry J. Zimmerman & Kitsantas, 1997). Therefore, Zimmerman's viewpoint on goal orientations is that with time, process goal learners start to see outcome rewards as milestones in lifelong mastery process rather than setting the outcome goal on winning a particular competition. The process goal orientation, also labelled as mastery orientation (Ames, 1992) was shown to sustain motivation, improve knowledge acquisition and performance better than the performance goal orientation (P. Pintrich & Schunk, 1996).

The second phase in Zimmerman's self-regulation model is the performance or volitional control phase. Performance or volitional control phase has two categories of self-regulatory processes: 1) self-control and 2) self-observation. Explicitly, self-control includes self-instruction, imagery, attention focusing, and task strategies.

Self-instruction is learner's effort in describing how to proceed with the learning task. Imagery is the method of constructing pictures mentally in order to improve performance. For example, Garfield and Bennett (1985) reported the case where sports psychologists taught their trainees to imagine successful execution of their planned routine in order to improve their actual performance. The third form of self-control is attention focusing. Attention focusing refers to learner's deliberate mental efforts to screen out external distractors for improving his concentration. Finally, task strategies refer to learner's effort in reducing a task to only essential parts, and reorganizing the parts in a meaningful order. For example, learners taking history lessons might identify key points and arrange them chronologically. The second category of performance control phase is self-observation. Self-observation refers to tracking of specific aspects of their own performance, the conditions surround it, and the effects that it produce.

The third phase in Zimmerman's self-regulation model is the self-reflection phase. Self-reflection phase involves processes that occur after performance efforts which influence one's response to that experience. Based on the study on self-reflection of Bandura (1986), Zimmerman includes self-judgement and self-evaluation of one's performance as parts of this process. Self-evaluation refers to comparing self-monitored information with a standard or goal. Self-judgement refers to judging one's performance, which is comparatively easy when it generates simple objective outcomes, such as being able to swim, drive an automobile etc. However, judging complicated outcomes depend on refined criteria, which ultimately depends on the sensitivity of one's self-judgements (Zimmerman & Paulsen, 1995). Thus, experts set challenging criteria for self-evaluation based on this mechanism (Ericsson & Lehman, 1996). Self-evaluation and self-judgments are linked closely to self-satisfaction. Self-satisfaction involves perceptions of satisfaction or dissatisfaction and the associated affect regarding one's performance, which is important because people pursue courses of action that result in satisfaction and positive affect, and avoid those courses that produce dissatisfaction and negative affect, such as anxiety (Bandura, 1991).

Zimmerman's theory is an important development in self-regulated learning, since the theory is based on psychological and empirical studies in different learning fields. His theory adopts the cyclic approach, with self-regulatory processes that are also included in other self-regulated learning models, such as self-efficacy, goal orientations, and task-strategies. Zimmerman's theory is different from other models in the sense that the model discusses self-reflection, which concerns different types of learning outcomes that the learner is self-monitoring. He argued the importance of self-evaluation when the learning outcome is complex, and stated the significance of self-satisfaction in self-evaluating learning outcomes.

### 2.1.2 Pintrich's self-regulated learning model

This study adopted the self-regulated learning model by Pintrich (2000), originally used in academic learning context among university students in the United States. A general working definition of self-regulated learning given by Pintrich (2000) is that "it is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and contextual features in the environment." The influences of these self-regulatory activities on overall achievement are affected by individual and contextual characteristics. In detail, the social-cognitive theoretical framework on which the model was founded assumes that learning motivation and learning strategies are not traits of the learner, but motivation is dynamic and contextually bound and that learning strategies can be learned and brought under the control of the student (McKeachie, Duncan, & McKeachie, 2010). That is, that students' motivation varies for different courses (e.g. different interest in elective course versus mandatory course; more efficacy for an easier course compared to a difficult course) and that their strategy use might vary as well depending on the nature of the academic tasks (e.g. multiple-choice versus essay exams).

Although the definition is relatively simple, self-regulated learning is largely concerned about the various processes and areas of one's regulation in learning and achieving outcomes. The theory can accommodate diversity and complexity in

studying self-regulation in learning. The bodies of literature on self-regulated learning cover different regions and sectors. For example, it is used to study the postgraduate computer learning in Hong Kong (Law, Lee, & Yu, 2010), undergraduate e-learning in the US (Duffy & Azevedo, 2015), nurse training in the US (Pintz & Posey, 2013), e-learning research in Europe (Carneiro, Lefrere, Steffens, & Underwood, 2011), tourism education of secondary school in South Africa (Adukaite, van Zyl, Er, & Cantoni, 2017).

Pintrich conducted series of empirical studies in refining and substantiating the self-regulatory processes in self-regulated learning theory. Specifically, waves of studies were conducted in the development and implementation of Motivated Strategies for Learning Outcome Questionnaire (MSLQ). The early development of this instrument involved usual statistical and psychometric analysis, including internal reliability coefficient computation, confirmatory factor analysis (CFA), and correlation with academic performance and academic performance measures (SAT scores). After each wave, Pintrich and his colleagues rewrote the items and refined the conceptual model (the self-regulated learning model) underlying his instrument. Through this process, the self-regulated learning model was refined.

Different from Zimmerman's cyclic approach to self-regulated learning model, Pintrich (2000) conceptualizes SRL as a combination of four processes for regulation during learning: cognition, metacognition, motivation, and resource management (Pintrich, 2000; Schraw, Crippen, & Hartley, 2006). Among these four areas, Pintrich further categorized cognition, metacognition, and resource management into learning strategies (Pintrich, 2000). Cognition refers to mental operations, procedures and processes that the learner engages in to acquire, integrate, organize, and retain new information. Metacognition refers to specific processes by which the learner evaluates or monitor their own thinking and knowledge structures, such as setting goals and self-monitoring. Motivation refers to learners' beliefs in their capacity to learn, their values for the task, and their interest level. Finally, the resource management refers to learners' behaviors regarding changing tasks and learning conditions.

Specifically, cognitive strategies include rehearsal, elaboration, organization, and critical thinking. Basic rehearsal strategies involve reciting or naming items from a list to be learned. Elaboration strategies include paraphrasing, summarizing, creating analogies, and generative note-taking. These help the learner integrate and connect new information with prior knowledge. Examples of an organizing strategies are clustering, outlining, and selecting the main idea in reading passages. Organization strategies help the learner select appropriate information and also construct connections among the information to be learned. Critical thinking refers to the degree to which learners report applying previous knowledge to new situations in order to solve problems, reach decisions, or make critical evaluations with respect to standards of excellence.

Meta-cognitive strategies consist three processes: planning, monitoring and regulating. Planning activities such as goal setting and task analysis help to activate relevant aspects of prior knowledge that make organizing and comprehending the material easier. Monitoring activities include tracking of one's attention as one reads, and self-testing and questioning; these assist the learner in understanding the material and integrating it with prior knowledge. Regulating refers to the fine-tuning and continuous adjustment of one's cognitive activities. Regulating activities are assumed to improve performance by assisting learners in checking and correcting their behavior as they proceed on a task.

Motivational processes include intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, and test-anxiety. Intrinsic goal orientation concerns the degree to which the learner perceives himself to be participating in a task for reasons such as challenge, curiosity, and mastery. Extrinsic goal orientation concerns the degree to which the learner perceives himself to be participating in a task for reasons such as grades, rewards, performance, evaluation by others, and competition. Task value differs from goal orientation in that task value refers to the student's evaluation of the how interesting, how important, and how useful the task is. Control of learning beliefs refer to learners' beliefs that their efforts to learn will result in positive outcomes. It concerns the belief that outcomes are contingent on one's own effort, in contrast to

external factors such as the teacher. Self-efficacy for learning and performance is the self-appraisal of one's ability to do well in the learning and perform well in the examination. Test anxiety is thought to have two components: a worry, or cognitive component, and an emotionality component. A worry refers to learners' negative thoughts that disrupt performance, while the emotionality component refers to affective and physiological arousal aspects of anxiety.

Resource management strategies include three components: effort regulation, peer learning, and help seeking. Effort regulation is a type of self-management that reflects a commitment to completing one's study goals, even when there are difficulties or distractions. Peer learning refers to learning with peers such as interacting through dialogue to help the learner clarify learning materials. Help seeking specifies the action of the learner to refer to peers for help, when the learner notices that they do not understand something and reach insights one may not have attained on one's own.

### 2.1.3 Learning outcomes in the context of self-regulated learning

Self-regulated learning was originally developed in the context of student learning in the classroom, and thus studies mainly focused on the influence of SRL on learning outcomes measured by academic achievement ( Zimmerman, 1990; Zimmerman, Bandura, & Martinez-Pons, 1992; Young, 1996; Eom & Reiser, 2000; Hwang & Vrongistinos, 2002; Dettori & Persico, 2011). Although academic achievement was the main concern during the early development of the theory, Zimmerman discussed the importance of affective outcomes such as learning satisfaction as a part of the self-reflection phase in SRL model (Zimmerman, 2002). He asserts that self-satisfaction and positive affect regarding learner's performance is one form of self-reaction in self-reflection phase. The affective outcomes such as learning satisfaction and attitudes have been widely examined (Eom, Wen, & Ashill, 2006; Kuo et al., 2014; Littlejohn, Hood, Milligan, & Mustain, 2016).

Furthermore, Zimmerman's concept of adapting self-satisfaction as the affective learning outcome in self-reflective processes has clear resonance with Pintrich's discussion on goal orientations (Pintrich, 2000; Zimmerman, 2000). Pintrich laid

out two goal orientations: 1) mastery orientation, and 2) performance orientation. Mastery orientated goals are represented by attempts to improve or promote competence, knowledge, skills where the evaluation standards are self-referential with focus on progress and understanding (Pintrich, 2000). In contrast, performance orientated goals are represented by attempts to outperform others using normative standards. Pintrich argued that both mastery orientated and performance orientated goals will influence affective learning outcomes such as self-satisfaction as part of the reaction and reflection phase in self-regulated learning (Pintrich, 2004). For example, Artino showed that two mastery orientations in SRL, namely, task value and self-efficacy, are positively affecting learning satisfaction in an online military training course (Artino, 2007).

The discussion on affective learning outcomes is not only limited to the academic learning context, but in the bodies of literature in training evaluation as well. Kirkpatrick's (2014) four-level model has been widely applied in training evaluation (Kirkpatrick, 2014). His model provides a general framework in business training context. In his model, training effectiveness is evaluated using four criteria: trainee reaction, learning, behavior, and business results. These four criteria occur in a sequential order, specifically, trainee reaction refers to the positive affective reactions from employees after the training, learning means the degree to which learning of contents occurs, behavior refers to the extent to which the training program leads to desired changes in workplace behavior, finally business results refer to the degree to which the training program leads to anticipated business results. Researchers have elaborated on specific levels of the model, for example to ensure better measurement, trainees' reactions were conceptualized as consisting of utility- and affective-type reactions (Alliger, 1997). Affective reactions are often measured as level of satisfaction with the training, using questions such as "I found this training program to be enjoyable." Utility measurements tap into the degree to which trainees feel the training program will benefit their ability to perform jobs. For the learning and behavior criteria, trainees have to learn the training content and then apply such learning in the workplace (Zhao, 2009). The effectiveness of a training program can thus be conceptualized as being composed of training

acquisition (learning) and transfer of training (behavior) (Tracey et al., 2001). Training acquisition refers to the learning and retention of material or content administered in a training program by trainees. Transfer of training refers to the application of acquired knowledge to the workplace, thus it is an important indicator of training effectiveness (Baldwin & Ford, 1988). Previous empirical studies asked trainees' behavioral intentions to apply the acquired knowledge as a measurement for transfer of training (Singh, 2014, Zhao, 2009). However, a meta-analysis of research in training revealed moderate correlations between utility reactions and transfer, and found a moderate relationship between learning and retention and behavioral changes (Alliger, 1997). Based on the bodies of literature in discussing affective learning outcomes, it may be important to account for factors intervening between the training program and the application of learning in workplace. Previous studies suggested that individuals' level of post-training self-efficacy will moderate their intentions to apply learning acquired during the training in workplace (Zhao, 2009, Tracey et al., 2001, Colquitt, 2000, Haccoun & Saks, 1998).

Given the discussion on learning outcomes from academic achievement to affective learning outcomes and the behavioral intentions, previous studies demonstrate this evolution of learning outcome measurements. Pintrich & De Groot (1990) show the correlational relationships between motivational orientation, self-regulated learning, and learning outcome using classroom academic performance. They found that 1) intrinsic value positively correlates with self-efficacy, strategy use, and self-regulation, 2) cognitive strategy use does not correlate with test anxiety, and 3) self-regulation positively relates to test performance. Sariscsany (1997) studied on the effectiveness of interactive videos for improving pre-service elementary school teachers' professional competence, using declarative knowledge as the learning outcome assessment. The study found that teachers studying with interactive videos score higher in the declarative knowledge test. Hwang & Vrongistinos (2002) conducted a study on elementary in-service teachers' self-regulated learning strategies in relation to their academic achievements. The study utilized subjective assessment on collected reports, and developmental portfolios as learning outcome

measurements. More recently, Johnson, Gueutal, & Falbe (2009) studied on e-learning effectiveness in training among 914 individuals with different age and backgrounds. The study utilized course satisfaction and course performance as the learning outcome measurement. Similarly, Pintz (2012) examined the e-learning effectiveness for preparing nursing students to enter higher education, and applied satisfaction as the learning outcome measurement. The preliminary study result shows that students are having positive learning satisfactions.

By reviewing the literature on learning outcomes in the context of self-regulated learning, the evolution of learning outcome can be observed. The learning outcome started as “academic grade” and evolved into more diverse measurements such as affective learning outcomes, learning satisfaction, behavioral intentions, and subjective assessments.

#### 2.1.4 SRL and in-service teacher training

Self-regulated learning is relevant to in-service teacher training as teachers often face the need to continuously improve themselves. Fullan views professional development for teachers to be both ongoing and dynamic (Fullan, 2007). Borko (2004), Wesley and Buysee (2001) report that teachers are often called upon to restructure their professional practices, across community and institutional, formal and informal, and all levels of education. On one hand, teachers are asked to revise practices to match shifts in societal structure, values, or resources, for example, to integrate emerging technologies into classrooms (Rennie, 2001). On the other hand, teachers are expected to realign practices in line with evolving learning theories, such as constructivist learning theory (Butler, Lauscher, Jarvis-Selinger, & Beckingham, 2004). With this background, SRL is of importance to teachers since they are engaged in the training activities that promote on-going reflections on practices aligning new policies and learning theories (Borko, 2004). Teachers are also expected to identify instructional principles with the learning theories (Isikoglu, Basturk, & Karaca, 2009), plan activities consistent with such principles (e.g. conducting student-centered lesson), carry out their plans in practice, monitor outcomes, and critically reflect on their efforts (Henry et al., 1999; Perry, Walton, &

Calder, 1999). Therefore, self-regulated learning skills are critical in teachers' in-service development since these skills are relevant in their self-development processes.

#### 2.1.5 SRL and in-service teacher training in Mongolian context

The Mongolian educational sector experienced a series of reforms from the 1990s. Teachers are expected to adapt to the new policies, curriculum, and pedagogies including student-centered teaching and learning and the use of ICT in educational activities (MECSS, 2012b; UNESCO-IBE, 2011). School-based teacher training is taking place for facilitating these movements in policies and practices. Provided with these learning opportunities are prevailed on the local school level, it is vital for Mongolian primary school teachers to be motivated to learn and practice different pedagogies, reflect their professional practices, discuss and collaborate with peers to solve issues, and create environment to conduct self-development (Mon-Educ Consulting LLC, 2017). Since SRL theory is focusing on learning motivations and learning strategies such as reflecting the knowledge, creating learning environment, and collaborating with peers, it can serve as a fundamental theory to understand teachers' motivation and learning strategies in teacher training.

## 2.2 Interactive learning materials

### 2.2.1 Emergence of interactive learning materials

Since the introduction of computers as educational tools, strength of employing multimedia using computers for teaching and learning is to provide students with an interactive learning experience (Kennedy, 2004). Reviewing the history in discussing computer-mediated learning, Hannafin and Peck (1988) argues that “the greatest advantage of computerized instruction is the potential for interaction during a lesson” (Hannafin & Peck, 1988, p. 17). Further, Bransford and co-workers (1999) discussed the important of interactivity in the context of computer-based instruction, suggesting that “interactivity makes it easy for students to revisit specific parts of the environments to explore them more fully, to test ideas, and to receive feedback” (Bransford, Brown, & Cocking, 1999). Several studies also

revealed specific benefits of interactive material, as facilitating learners' cognitive activity (Kennedy, 2004; Rogers & Scaife, 1998). Cairncross & Mannion (2001) and Domagk et al. (2010) also argue that interactive features such as learner control over pace may influence learners' emotions and motivation. As indicated, bodies of literature claim that interactivity is presented as an attribute of learning environments that enhance the quality of educational materials and that can facilitate learning.

### 2.2.2 Types of interaction in interactive learning materials

Moore (1989) introduced three types of interaction in distance learning context: 1) learner-content interaction, 2) learner-instructor interaction, and 3) learner-learner interaction (Moore, 1989). Learner-content interaction refers to the interaction between the learner and the content for the subject of study. Learner-content interaction is considered as the intellectual process in interacting with the learning content that changes learner's understanding, or cognitive structures in his mind. Learner-instructor interaction refers to the interaction between the learner and the expert who prepared the distance learning material, such as the support given by the instructor. Learner-learner interaction refers to the interaction between one learner and other learners, either individually or in groups such as group discussion and feedback.

There are two different focuses in discussing learner-content interaction. First, during the late 1980s and 90s, functional interactivity literacy promoted a discussion among educators. This interactivity can be classified in terms of input devices (e.g. keyboard, mouse, touch screen) or features provided (e.g. hypertext, multimedia) (Hannafin, 1989; Schwier & Misanchuk, 1993; Sims, 1997). In these cases, interactivity is defined as an attribute of the medium, with less focus on the dynamic relationship between the learner and the interactive learning system. Therefore, functional interactivity has a clear focus on the system, not on the learner. As the above approach is of limited use for research on the effectiveness of interactivity in multimedia learning because they do not sufficiently consider the learner's learning processes, there were arguments that interactive learning

environment has functional interactivity attributes, but such environment alone is not sufficient (Domagk et al., 2010; Kennedy, 2004). Instead a learner must release the potential of functional interactivity by establishing a dynamic relationship (Kennedy, 2004). Therefore, starting 2000s, the discussion on cognitive interactivity emerged, which focuses on learners' use of learning strategies to mentally process the knowledge presented in the interactive learning system (Kennedy, 2004; Moreno & Mayer, 2007).

Recent literature advances the previous discussion on interactivity in computer-mediated learning systems. Domagk et al. (2010) argue that interactivity is not the function of the learning system alone, nor merely the cognitive activities of the learner, but rather, interactivity should be viewed as reciprocal activity between learner and an interactive learning system. Therefore, learner is at the core in establishing a dynamic, meaningful relationship with the interactive learning environment to make effective learnings occur.

### 2.3 SRL and interactive learning materials

This section discusses the relationship between components in SRL (using Pintrich's theory) and learning with interactive materials. Learner's ability to conduct self-regulated learning is vital in achieving learning objectives particularly in the environment that regular guidance and support from the instructor are not available. Such learning environments are different from traditional learning and training settings where the activities are structured and monitored. Instead, learning motivation and self-management skills are important assets for learners to succeed in learning with interactive materials (Lynch & Dembo, 2004). Interactive learning materials have the potential to foster SRL, and the following sub-sections discuss how SRL can be supported by interactive learning materials.

#### 2.3.1 Interactive learning materials and learning motivation

Keller (2008) explained how interactive learning materials can potentially foster learning motivation through Attention, Relevance, Confidence and Satisfaction Model (ARCS Model). First, it is possible to use approaches such as including interesting graphics, animation to gain learner's attention. Learner's attention can

be further deepened into curiosity (intrinsic motivation) by introducing mysterious or unresolved problems, which stimulates a sense of inquiry in the learner. Second, including learning contents that are relevant to learner's previous knowledge and learning activities may also promote intrinsic motivation. The contents that are personally interesting and can be freely chosen by the learner are relevant in promoting task value. Third, self-efficacy for learning and performance can be promoted by building confidence in learners through giving constructive feedbacks, which may reinforce positive behaviors and skills. Fourth, control of learning beliefs is potentially promoted by presenting materials that learners can immediately apply into real world settings, which gives satisfaction to learners.

Previous studies also examined the influence of interactive learning materials on learning motivation. Moshinskie (2001) suggested several features in interactive learning materials that may promote learning motivation. The varying presentation of information, such as the incorporation of video, graphics, and stories that are integrated in puzzles can promote learning motivation. He also asserts that the provision of legitimate feedback, for example, a confirmation of learner's effort may promote intrinsic motivation. Hardré (2008) explained that learner's learning motivation is malleable, depending on the implementation of the learning environment. He further explained that interactive learning materials that maximize learner choice and flexibility, and provide individualized, competence-informing feedbacks can enhance learning motivation. Law, Lee and Yu (2010) assessed the influence of a e-Learning system on learning motivation, named Programming Assignment Assessment System (PASS). The PASS system contains interactive quizzes and prompt feedbacks that set clear learning goals for learners to practice programming skills. The authors found out that PASS system can facilitate both learner's intrinsic and extrinsic motivations, and these motivations have positive effect on self-efficacy. Buckley and Doyle (2016) designed a gamified learning material that incorporate interactive features such as rapid feedback to learners and presentation of challenges. Through pre- and post-test, the authors found that a gamified learning material can promote intrinsic motivation's impact on student's declarative knowledge.

Synthesizing the discussions in the body of literature on interactive learning materials and learning motivation, it is clear that interactive learning materials have the potential to promote learning motivation. Table 2-1 shows the summary of the discussions. Through interactive features focusing on quizzes, learning motivation can be promoted by three content characteristics in interactive materials. First, the inclusion of interesting and relevant multimedia contents can promote intrinsic motivation and task value. Second, answers that can be freely chosen by learners may enhance intrinsic motivation. Third, positive and constructive feedbacks may enhance learner's self-efficacy for learning, their control of learning beliefs, and extrinsic motivation.

**Table 2-1: Analyzing relationships between interactive learning materials and learning motivation**

Interactive features	Content characteristics	Potential learning motivation promoted
Multiple choice questions, Fill-in-gap (complete sentence by ordering fragments), True and false questions	1. Inclusion of interesting graphs, related and useful information about subject-specific pedagogies	Intrinsic motivation (reasons why learner is engaging in a learning task, such as curiosity and challenge) Task value (learners' evaluation of how interesting, important and useful the task is)
	2. Answers that are free to choose from	Intrinsic motivation
Feedback based on learner's input	3. Positive and constructive feedback to either correct or incorrect answers	Self-efficacy for learning and performance (self-appraisal of one's ability to master a task) Control of learning beliefs (belief that their efforts will result in positive outcomes) Extrinsic motivation (reasons to engage in learning task because of wanting to get better scores, or assessment results)

Source: created by author.

### 2.3.2 Interactive learning materials with cognitive and metacognitive strategies

Interactive learning materials may also influence learner's use of cognitive and metacognitive strategies. Park and Hannaffin (1993) discussed explicitly the design

principles for interactive learning materials that may facilitate learner's use of cognitive and metacognitive strategies. First, the presentation of information in multiple perspective such as texts, pictures, and videos can promote the effectiveness of using rehearsal skills. It is argued that information presented in text is often better recalled and retained when supplemented with pictures. Second, interactive learning materials that integrate summaries in places such as feedback and end-of-segment may help learners conduct organization and elaboration activities. These information that appears after the learner conducts a learning task, e.g. answering a quiz, prompts learners to summarize key relationships among learning contents, which in turn assists new knowledge to be integrated into learner's knowledge system. Third, interactive learning materials that includes adaptive feedbacks is effective in promoting critical thinking. Feedback as a reflection to the learner provides learners to elaborate understanding and associate existing knowledge with new knowledge. Based on feedbacks, learners can generate questions and raise issues related to completed activities, which is a critical thinking activity. Fourth, in terms of metacognitive activity, Park and Hannaffin stated that the provision of prompts and self-check activities to aid the learner in monitoring comprehension and adapting individual learning activities can elicit metacognitive activity. Through self-check activities, learners can link concepts in their own understanding, self-generate questions to be answered, and review related concepts within the interactive learning materials. These mental activities are all part of the use of metacognitive skills.

Previous studies demonstrated how interactive learning materials can support learner's use of cognitive and metacognitive strategies in learning mathematics. Kramarski and Gutman (2006) compared two learning environments, one supported with self-metacognitive questioning and one without the support. The self-metacognitive questioning refers to three specific features: 1) questions to stimulate comprehension and connection of knowledge, 2) requirements for learners to explain their answers, reflect on the answers, and suggest ways to improve, and 3) interactive feedbacks on the correctness of the answer. The study found out that learners supported with self-metacognitive questioning outperformed

their peers in using self-monitoring strategies, i.e. metacognitive strategies. Krause, Stark and Mandl (2009) examined whether specific types of feedback intervention may have an effect on learner’s use of cognitive strategies in an e-learning context. Krause et al. showed that the elaborated feedback which highlights mistakes and offers explanations or other additional information helps learners reflecting on the presented information and on their own knowledge. The elaborated feedbacks thus facilitate elaboration of the materials, correction of misconceptions, and filling of knowledge gaps. Kong (2014) investigated a flipped classroom where learners are conducting self-learning using e-learning resources on computers. Learners are given sufficient time to think about the problem-solving questions in the e-learning materials. The study identified a significant growth in learner’s use of critical thinking skills when they are provided with enough time to consider the questions in the e-learning materials by themselves.

Table 2-2 summarizes the discussion in the body of literature on interactive learning materials supporting the use of cognitive and metacognitive strategies. Three interactive features with five content characteristics are identified. First, through various types of quizzes, interactive learning materials can integrate different formats of learning materials. Together with the prompting of self-checking, the quizzes can elicit learner’s use of rehearsal and metacognitive skills. Second, the presentation of summary of information in specific places such as the end of a learning unit may encourage learner’s use of organization and elaboration skills. Third, feedbacks in interactive materials can adaptively give explanations on new knowledge, and where the learner did mistake when applicable. These personalized feedbacks may promote learner’s use of critical thinking abilities.

**Table 2-2: Analyzing relationships between interactive learning materials and cognitive plus metacognitive strategies**

Interactive features	Content characteristics	Potential cognitive and metacognitive strategies used
Multiple choice questions, True and false questions, Order the sequence, Fill-in-gap	1. Presentation of information in multiple formats such as texts coupled with graphics	Rehearsal skills (recite or name learning contents, activate information in working memory)

(complete sentence by ordering fragments)	2. Prompt of self-checking activity, self-monitoring of knowledge level	Metacognitive skills (planning, monitoring and regulating the learning)
Summary of information inserted at the end-of-segment	3. Summarization and additional information of knowledge presented in learning material	Organization skills (clustering, outlining, selecting main idea) Elaboration skills (paraphrasing, summarizing, note-taking for long-term memory)
Feedback on quizzes based on learner's input	4. Explanation on the new knowledge being studied 5. Explanation on the knowledge where learner did mistake	Critical thinking (apply previous knowledge to new situation to solve problem)

Source: created by author.

### 2.3.3 Interactive learning materials and resource management strategies

The support of peer learning and help seeking by interactive learning materials is often related to the learning context deploying such materials. Coopey, Danahy and Schneider (2013) demonstrated a web-based interactive learning environment. Learners are arranged in a common space with shared screen of the interactive material. The interactive learning material allows groups of learners to arrange ideas spatially for sense making. Through a shared interactive material, peer learning and help seeking are facilitated. McDonough and Foote (2015) explained an interactive learning system where learners are required to response to quizzes by using clicker device. It is found that learners are more likely to engage in collaborative reasoning and select the correct answer during shared clicker activities. Esquela-Kerscher et al. (2016) demonstrated the interactive learning materials that are used in peer-to-peer learning. The interactive materials contain quizzes and feedbacks intended for learners to walk through in small groups. The study found out that the interactive materials are effective in promoting peer-to-peer learning in groups, and such learning can lead to better learning satisfaction.

In terms of time management, Capper (2001) claims that the advantage of interactive learning materials, or e-learning materials is the ability to let the learners study from any place when they are ready to learn. This convenience gives students better choice in where and when they learn. Indeed, Liaw and Huang (Liaw &

Huang, 2013) confirms that interactive learning material’s ability for learners to learn at their preferred time and place does enhance learner’s perceived learning satisfaction and the use of self-regulation skills. The last resource management process, effort regulation, refers to a learner’s management of commitment to achieve learning goals. This is a construct that is related to the learning goals, which is part of the motivational process. Cho and Shen (2013) studied the effectiveness of an interactive learning environment using online Blackboard system. Learners in the study conducted self-learning without meeting instructors. The study found out that intrinsic goal orientation and self-efficacy are positively associated with effort regulation, which then positively associates with learner’s achievements.

Table 2-3 summarizes the discussion regarding the influence of interactive learning materials on resource management processes. The influence is largely depending on the learning context of the interactive learning materials. First, the implementation of interactive materials with a group, or in an environment where learners can conduct face-to-face debating, may elicit the use of peer leaning and help seeking skills. Second, the advantage that interactive materials can be used anytime and anywhere is useful for learners to conduct self-development when they are convenient. This feature may help learners in conducting time and study environment management, as well as effort regulation.

**Table 2-3: Analyzing relationships between interactive learning materials and resource management processes**

Learning context of interactive learning materials	Potential resource management processes used
Group study with interactive material projected on screen, group discussion and face-to-face debate on quizzes and information presented	Peer learning (collaboration and dialog with learner’s peers to clarify learning materials and reach insights) Help seeking (identify someone to provide the learner with assistance when he does not understand)
Self-paced learning using interactive material at teacher development center in school or at home	Time and study environment management (scheduling, planning, and managing one’s study time and study environment) Effort regulation (self-management reflecting a commitment to completing his study goals)

Source: created by author.

## Chapter 3 Development of interactive materials

### 3.1 Motivation behind the development of interactive materials

The motivation of developing interactive materials for primary school teacher training in rural Mongolia started from the author's previous findings on teachers' educational integration of ICT. It was found that endogenous factors such as teachers' professional competency, perceived benefits on use of ICT, and teacher collaboration are important factors affecting teachers' perception on use of ICT tools and digital contents for student-centered education. Therefore, the study result suggested that ICT integrated in-service teacher training programs could have the potential to improve teachers' professional competency, to give an example. With this background and the motivation of primary school teachers to use ICT for teacher training, the technological opportunities regarding videos and multimedia contents for distance learning were explored.

Distance learning has long been a method to provide accessible, affordable educational contents to people in need. The recent trend of distance learning is to provide educational contents, mostly in the format of video via Internet (Chen, Barnett, & Stephens, 2013). There are multiple successful and established online platforms such as Coursera which provides a comprehensive learning experience to remote learners. One aspect that is often mentioned in literatures is that distance learning faces challenges in retaining motivation from learners (Stevanović, 2014). Koller (2012) suggested four approaches to address this issue by 1) introducing quizzes integrated in the learning videos, 2) asking students to complete questions after looking at the videos, 3) create peer-review schemes to allow human scrutiny on subjects requiring critical thinking, and 4) virtual and physical off-line study groups.

Through investigation of available tools, multiple tools were identified to create interactive materials for teachers' learning in teacher training. These tools included Adobe Captivate 9, Articulate Storyline 2 and other commercial software. The trial version (available for 30 days) of Adobe Captivate 9 was utilized to create interactive quizzes with pictures. Production of interactive materials utilized source

materials such as Bayankhongor teacher training videos with English subtitle, as well as teacher training guideline in English.

### 3.2 Initial consultation

In September 2015, the prototype interactive material was demonstrated to five professors who are curriculum development experts in teacher education, and Prof. Tsudevsuren who is the Dean of Computer Science in Mongolian National University of Education (MNUE). The presentation demonstrated the prototype of interactive teacher training material which has the ability to integrate functions such as quizzes, fill-in the blank, multiple choices to trigger learners' interests and provide instant feedback. The provision of quizzes in the format of interactive materials is to serve as a tool for teachers to conduct self-learning on the school and individual level. The prototype was produced for initial consultation in Mongolia with subject of Man and Environment.

There were two major recommendations based on the initial consultation. First, the content development model for interactive teacher training material should be constructed. Second, suitable software required for developing off-line interactive learning materials needs to be identified.

### 3.3 Tool selection

In consultation with local professionals, nine local characteristics in selecting authoring tool were identified as follows.

- 1) Offline support: the interactive training materials should be able to operate offline considering limited Internet connection in rural primary schools and villages;
- 2) Content coding: HTML5 and JavaScript are preferable projecting future trend;
- 3) Cost: Free and Open Source Software (FOSS) is preferable, creation and share of contents are unlimited;
- 4) Language: must support contents in Mongolian language;
- 5) Usability: interactive materials should be easily created and utilized;

- 6) Potential content creators: mentor teachers, methodologists, and interested professors in MNUE;
- 7) Target content users: primary school teachers;
- 8) Local sustainability: local content creators continue creating contents for primary school teachers;
- 9) Software sustainability: the software is constantly supported and maintained.

Five representative tools are reviewed as shown in Table 3-1, satisfying the above mentioned criteria. There are five technical criteria to compare the authoring tools:

1) ability to support offline usage, 2) the coding of the contents, 3) license, 4) usability, and 5) software sustainability. Two key factors are offline support, and license as the Internet connectivity may be limited in rural areas of Mongolia and the future expansion of the software depends on free and open source license. It should be noted that Xerte could output interactive materials that can be used offline, through the support of XAMPP which is a local server environment.

Meanwhile, the contents created in H5P could also be used offline, but the set-up of XAMPP is considered challenging for content users. Xerte stands out among the tools compared thanks to its ability in supporting content creation and usage offline, as well as its FOSS nature. Three of the commercial software offer better user experience, and two of them require less initial set-up. However, the cost in distributing genuine version of such software is not feasible in the scope of this study. Almost all tools are catching up with latest coding standard with backward compatibility to Flash. This is in trend with latest development of media standards to cater cross-platform content development, and the gradual phase-out of Flash. All software reviewed are actively maintained.

For future content creators and users when the Internet is connected to all local beneficiaries, the authoring tool may be deployed on a server which could offer the following advantages. First, content creators can access the creation tool remotely. Second, content users can use the materials remotely. Third, all resources (quizzes, images, videos) can be managed centrally. Fourth, tracking can be deployed, such as the number of clicks, number of logins, and the number of times utilized to understand the usage of such systems.

**Table 3-1: Comparative analysis for selecting authoring tool**

	Xerte	H5P	Adobe Creative CC	Adobe Captivate 9	Articulate Storyline 2
Offline support	Yes	Yes	No	Yes	Yes
Coding	HTML5 / JS + Flash	HTML5 / JS	HTML5 / JS + Flash	HTML5 / JS + Fla0sh	Flash
License	FOSS	FOSS	Commercial	Commercial	Commercial
Usability	Initial set-up required only for content creation, easy to use	Initial set-up required for both content creation and content usage	Requires technical knowledge and Internet	Easy to use	Easy to use
Software sustainability	Actively maintained	Actively maintained	Actively maintained	Actively maintained	Actively maintained

Source: created by author.

### 3.4 Content development

Since teacher training guideline was written in Mongolian, thus the first barrier to overcome was the language barrier. Prof. Yamaguchi, Prof. Sukhbaatar and Ms. Orgilmaa kindly organized the translation of the teacher training guideline from Mongolian language to English. As a result of the efforts made by these Mongolian educational experts, as well as local translators, the full teacher training guideline was made available in English in late-October, 2015. This has become the source material for producing interactive materials.

#### 3.4.1 Development of quizzes and interactive materials

The development of quizzes relied on teacher training guideline. Teacher training guideline was the textbook for local primary school teachers and MNUE professors aiming at in-service teacher development between 2013 and 2016. The guideline contains the description of pedagogies and sample lessons plans for 8 subjects created by local teacher professional teams, reflecting the New Education Standard and the Core Curriculum (MECSS, 2014). The guideline is important for teachers' development because the contents reflect the new educational policies and are suitable for application in the local context.

There were four major processes in creating quizzes for Mongolian primary school teachers: 1) draft quizzes and feedback information based on teacher training guideline, 2) verify quizzes by MNUE professors of each subject, 3) reflect comments from professors, 4) translate into Mongolian language. There were multiple iterations of these four processes, such as multiple revisions in drafting process and multiple reflections of comments from professors. The finalized quizzes were the basis to create interactive materials. Based on the nature of the quiz, such as multiple choice, the quizzes were converted into different types of quizzes that the learner can interact with in the interactive materials (see Table 3-2). The feedback information will show up upon receiving an input from the learner, which varies depending on whether the input is correct or wrong.

#### 3.4.2 Verification of interactive materials by educational experts

Verification of the produced interactive materials were carried out with five Mongolian professors for three subjects, and Ms. Dolgorsuren, the methodologist of Bayankhongor Education Culture Department (ECD). These Mongolian educational experts offered valuable feedbacks in nudging the details of interactive materials. For example, Prof. Khukhuu provided extra photos to be included in Art and Technology subject material to enhance graphical experience. Every local expert offered advice on grammar accuracy, sentence structure, and language consistency. These professional advices were vital in ensuring the quality of interactive materials.

#### 3.4.3 Finalization

In summary, a total of 107 quizzes were produced for three subject interactive materials: Man and Environment, Man and Society, and Art and Technology. Table 3-2 below summarizes the types of quizzes included and the number of quizzes for each subject interactive material. Interactive material of each subject mixes different types of quizzes in attempt to keep teachers motivated in learning through the contents without getting tired of a particular type of quiz. These interactive materials are also reviewed and accepted by Ms. Inge Donkervoort, the administrator of Xerte Community website. The URL (shortened link by Google)

to access the materials is shown here: <https://goo.gl/7PUqB9>. Through this page, the user can directly utilize the interactive materials via their computer browser. Please also find the screenshots of the produced interactive materials in the Appendix 1.

**Table 3-2: Summary of types and number of quizzes in interactive teacher training material**

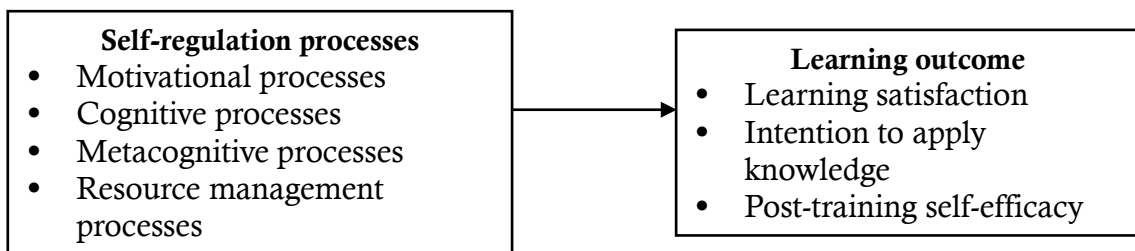
Type of quiz	Art and Technology	Man and Environment	Man and Society	Total
Drag-and-drop labelling	6	-	-	6
Multiple Choice Question	19	11	6	36
True and false	-	21	17	38
Gap fill	4	6	7	17
Timeline / Matching pairs	3	-	4	7
Free answer	-	2	1	3
Total	32	40	35	107

## Chapter 4: Methodology

This chapter lays out the methodology of the study. It first introduces the theoretical framework of this research. Following that, the development of interactive materials is explained. Then, moving onto the description of study design which explains the implementation details of the interactive materials for primary school teacher training. After that, the survey instruments and the data collection are described. Based on the collected data, the preparatory analysis and the construction of research framework based on the analysis results are shown. Lastly, the data analysis procedure is explained for addressing the research questions developed in the research framework.

### 4.1 Theoretical framework

Literature review explored the importance of SRL and affective learning outcomes for in-service teacher development, and the potential positive effects of interactive materials to teachers' SRL and affective learning outcomes. Based on this academic background, the research objectives are to 1) identify important self-regulation processes that affect teachers' learning outcome, 2) find out the influence of interactive materials on teachers' learning in self-development based on self-regulated learning (SRL) theory. Figure 4-1 shows the theoretical framework of this study.



**Figure 4-1: Theoretical framework**

Source: created by author.

The theoretical framework assumes that four self-regulation processes, namely, motivational processes, cognitive processes, metacognitive processes, and resource management processes are affecting learning outcome which is measured by learning satisfaction, intention to apply knowledge and post-training self-efficacy.

As explained in chapter 2, each self-regulation processes are based on Pintrich's SRL theory, with each process consisting multiple sub-scales. The explicit research framework is constructed based on preparatory analysis results, i.e. exploratory factor analysis and reliability analysis results. Another important point is that self-regulation processes and learning outcome are prone to change under different contextual features (e.g. task characteristics, feedback systems, evaluation structures) can facilitate or constrain and individual's attempts to self-regulate his or her learning (Pintrich et al, 2000, p.455). This means that the potential influence of interactive materials to self-regulation processes and learning outcome as a contextual feature can be taken into account.

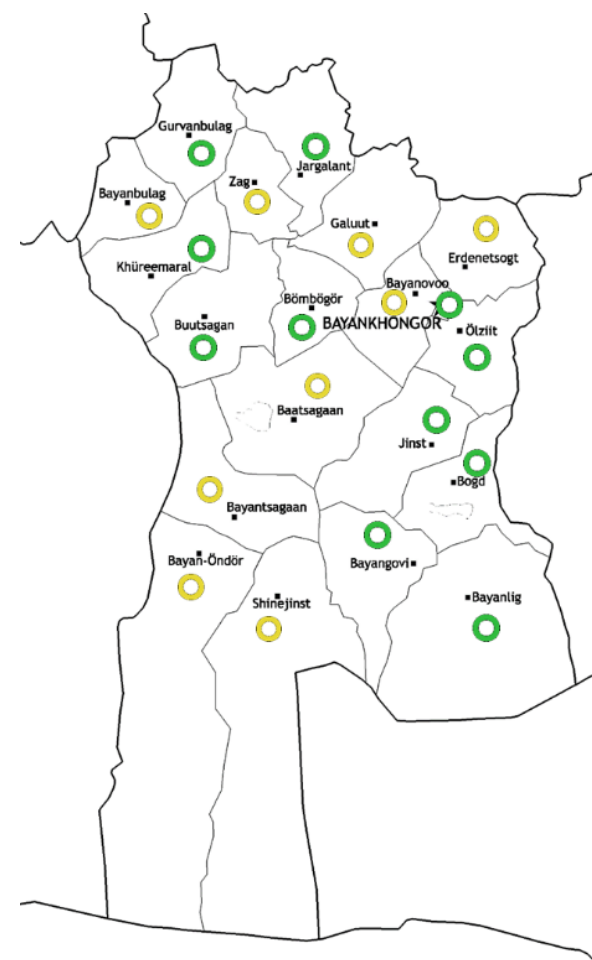
#### 4.2 Study design

This study employs the two-group experimental design where two groups of teachers were formulated in receiving teacher training in Bayankhongor Province, Gobi Region of Mongolia. The experimental group (teachers with interactive materials) refers to teachers who conduct self-development using interactive teacher training materials, teacher training guideline and teacher training videos. The control group (teachers without interactive materials) refers to teachers who conduct self-development using teacher training guideline and teacher training videos. There are 15 schools with 154 teachers in the experimental group, 14 schools with 131 teachers in control group. Referring to Figure 4-2 and Table 4-1, it can be seen that these two groups are composed of schools with comparable characteristics in terms of mixture of different sizes of schools, numbers of schools and teachers, similar school performances, and geographical locations. The intervention using interactive teacher training materials for teacher training took place in April, 2016 for teachers in experimental group. To ensure equal access to interactive materials for self-development and to avoid any potential negative impacts of intervention to teachers' professional competency, the teachers in control group participated the teacher training with interactive materials in September, 2017.

**Table 4-1: List of schools and number of teachers participating this study**

Group A Self-learning with interactive material		Group B Self-learning without interactive material	
School location	Number of teachers	School location	Number of teachers
Ölziit	9	Shinejinst	8
Jinst	5	Bayan-Öndör	10
Bogd	10	Bayantsagaan	9
Bayanlig	14	Baatsagaan	8
Bayangovi	11	Galuut	10
Nomgon	34	Zag	5
Erden	20	Bayanbulag	6
Sögöseikyō	11	Bayan-Ovoo	5
Bömbögör	8	Erdenetsogt	10
Buutsagaan	10	Shargaljuut	5
KhüreemaraI	4	Nomundalai	24
Gurvanbulag	8	Erdenemandal	19
Jargalant	10	Bayan-Oit	12
Total 13 schools	154	Total 13 schools	131

Source: created by author.



**Figure 4-2: Map showing the location of schools participating the study**

Source: created by author.

## 4.3 Instrument

### 4.3.1 Selection of the instruments

This study applies the survey instrument developed by Pintrich to measure Self-regulation processes and two survey instruments to measure learning outcomes. Motivated Strategies for Learning Outcome Questionnaire (MSLQ) was localized to measure self-regulation processes for teachers receiving in-service teacher training (Pintrich, 1991). MSLQ was selected due to its proven reliability and validity across multiple targets of study population and application in different regions (Kramarski & Michalsky, 2009; Kuo et al., 2014; McKeachie et al., 2010; Moos, 2010). For example, it was utilized in examining the correlational relationships between motivational orientation, self-regulated learning, and classroom academic performance among 7-th grade students (P. R. Pintrich & De Groot, 1990). MSLQ was also used for finding out the differences between motivation and learning strategies between high and low academic achieving in-service elementary school teachers (Hwang & Vrongistinos, 2002). For a broader research population, MSLQ was used in investigating the use of learning strategies of nurse students when studying interactive materials (Pintz & Posey, 2013). More recently, the instrument was applied in a study to find out the effect of self-regulation towards learning satisfaction in an online course (Kuo et al., 2014). Learning satisfaction survey and training effectiveness survey were selected to measure learning outcome. They are both measuring learner's satisfaction with learning contents in distance learning context (Pintz & Posey, 2013; Zhao & Namasivayam, 2009). Training effectiveness survey focuses on learner's intention to apply knowledge and post-training self-efficacy.

### 4.3.2 Localization of the instrument

There are four steps in localizing the survey instrument. The questionnaire consisting these three instruments were first reviewed by professors to eliminate irrelevant questions, and the change in wording of the questions to fit in Mongolian teacher training context. The revised questionnaire was then reviewed by Mongolian local educational experts. Following that, the revised questionnaire was

translated into Mongolian language by a team of Mongolian local educational experts. The Mongolian version questionnaire was tested with 20 primary school teachers in Nomgon school, Songinokhairkhan District of Ulaanbaatar City. As a result, the final instrument consists 5 items (for teachers without interactive materials) or 9 items (for teachers with interactive materials) in demographic section (Part A), 17 items measuring learning motivation (Part B), 36 items measuring learning strategies (Part C), and 13 items measuring learning outcome (Part D). Please find the questionnaire in Appendix 2.

All survey items are coded as 7-point Likert scale items. A 7-point Likert scale was adopted in the questionnaire as having more point scales reduces problems of normality issue and increases sensitivity (Leung, 2011). Further, 5-point Likert scale could cause information loss, and 7-point Likert scale is a preferred scale without over imposing cognitive load for respondents (Finstad, 2010). A dichotomous variable “Use of interactive material” is used to represent teachers using interactive material (value = 1) and teachers who do not use interactive material (value = 0).

#### 4.4 Data collection

##### 4.4.1 Quantitative data collection

Data collection took place in Bayankhongor province in collaboration with Bayankhongor ECD. The data were collected between September 2016 and November, 2016 using the localized survey instrument to enquire teachers’ use of self-regulation processes and learning outcome in learning the teacher training materials. Teachers in experimental group were given six months to utilize interactive materials for self-development either during group teacher training at school or at their own pace from April 2016 to September 2016. Teachers in control group conducted self-development using teacher training VCDs and guideline. Teachers in experimental group receive the questionnaire that has 4 extra items in demographics section (Part A) regarding their general user experience with interactive materials. Teachers in control group receive the questionnaire without these 4 questions, since these questions are irrelevant to them.

#### 4.4.2 Qualitative data collection

The interpretation of the study result is very important and the explanation is contextually related. In order to interpret and understand the study result, field visit was organized in Bayankhongor Province where the study was implemented. The study result was translated into Mongolian language and presented to the local primary school teachers. In total, feedback was received from 58 local primary school teachers and administrators. Specifically, three focus group discussions were conducted with 40 primary school teachers in three schools in Bayankhongor. Further, one focus group discussion was carried out with 17 primary school teachers from 14 primary schools across the province, who gathered in the province center for receiving professional development. Moreover, one interview was conducted with Bayankhongor Education Culture Department (ECD) methodologist, who supervises the teacher professional development programs within the province.

**Table 4-2: Summary of focus group discussion and interview**

<b>Participant</b>	<b>Date</b>	<b>Place</b>
12 teachers in province center	22 Sep., 2017	Erden School
9 teachers in province center	22 Sep., 2017	Sogoseikyo School
19 teachers in province center	22 Sep., 2017	Nomgon School
17 teachers and training managers from rural areas	24 Sep., 2017	Education Culture Department
Methodologist from Education Culture Department	25 Sep., 2017	Education Culture Department

#### 4.5 Preparatory analysis and research framework

This section illustrates two steps taken to identify the latent variables of the dataset. The identified latent variables are used to construct the research framework with the corresponding research questions.

##### 4.5.1 Step 1: Reliability analysis of theoretical components

The first step in data analysis is the factor analysis. As a preparatory step, descriptive analysis was applied to the dataset to identify potential issues in further analysis such as data points with input error or outliers. The descriptive analysis

also provides the overview of the data collected, such as the age distribution of the population. For the reliability analysis, Cronbach's alpha is utilized which is a measure of internal consistency (a measure of reliability). Cronbach's Alpha is a measurement of internal consistency which means how well the underlying items are measuring the scale, i.e. are multiple items measuring the same concept. Its value ranges from 0 meaning no internal consistency to 1 meaning perfect internal consistency, a numerical value for Alpha above 0.7 is generally accepted (L. Cronbach, 1951; Tavakol & Dennick, 2011). Cronbach's Alpha is used in this step to examine whether multiple Likert questions in the survey collected among Mongolian primary school teachers can form the theoretical scale, such as internal motivation scale in SRL that was defined by the original author of MSLQ survey.

The reliability analysis of the theoretical components can provide critical information in deciding what question items will be carried over for further analysis. The groups of items that do not theoretically form a scale show the sign of unreliability thus further use would require appropriate treatment. Specifically, items that cause reliability issue could be excluded to reassess the Cronbach's Alpha to see whether the reliability improves.

According to the reliability analysis result on Table 4-3, it is found that control of learning beliefs component in motivation scale has low internal consistency (Alpha < .700), therefore it is suggested to be removed. Similarly, for learning strategies scales, metacognitive self-regulation, time and study environment management, effort regulation, peer learning, and help seeking shows low internal consistency which is also suggested to be removed. All three components of learning outcome scales are displaying good internal consistency.

**Table 4-3: Reliability analysis of all theoretical components**

	Component	Cronbach's Alpha
Motivation scales	1. Intrinsic goal orientation	.759
	2. Extrinsic goal orientation	.700
	3. Task value	.782

	4. Control of learning beliefs	.571
	5. Self-efficacy for learning and performance	.822
Learning strategies scales	1. Rehearsal	.661
	2. Elaboration	.702
	3. Organization	.738
	4. Critical thinking	.789
	5. Metacognitive self-regulation	.499
	6. Time and study environment management	.267
	7. Effort regulation	-.034
	8. Peer learning	.627
	9. Help seeking	.038
Learning outcome scales	1. Learning satisfaction	.814
	2. Intention to apply acquired knowledge	.837
	3. Post-training self-efficacy	.725

Previous reliability analysis and multiple trials removing reversed items show that some reversed items do not measure the intended component well. Therefore, these items are removed for conducting further reliability analysis to observe if this operation may increase the internal consistency or not. Specifically, first, for metacognitive self-regulation, two reversed items are removed due to its high influence to internal consistency. Second, for time and study environment, one item is removed. Third, for effort regulation, one reversed item is removed. The new reliability test results are shown in Table 4-4.

**Table 4-4: Theoretical components retained based on reliability analysis**

	Component	Cronbach's Alpha	Retention
Motivation scales	1. Intrinsic goal orientation	.759	Yes
	2. Extrinsic goal orientation	.700	Yes
	3. Task value	.782	Yes
	4. Control of learning beliefs	.571	No

	5. Self-efficacy for learning and performance	.822	Yes
Learning strategies scales	1. Rehearsal	.661	No
	2. Elaboration	.702	Yes
	3. Organization	.738	Yes
	4. Critical thinking	.789	Yes
	5. Metacognitive self-regulation	.803	Yes
	6. Time / study environment management	.578	No
	7. Effort regulation	.698	Yes
	8. Peer learning	.627	No
	9. Help seeking	.580	No
Learning outcome scales	1. Learning satisfaction	.814	Yes
	2. Intention to apply acquired knowledge	.837	Yes
	3. Post-training self-efficacy	.725	Yes

As a result, question items belonging to components with Cronbach's Alpha > .700 are retained for further analysis.

#### 4.5.2 Step 2: Exploratory factor analysis (EFA)

Exploratory factor analysis is the second step in data analysis. This section discusses the rationale for applying EFA in this study. First of all, factor analysis is an interdependence technique, which means that the analysis does not distinguish between independent and dependent variables - it treats all variables (question items) the same. Second, varimax rotation is a method to simplify the factor matrix, the rotated principal components are uncorrelated if all items contributing to that principal component is taken into account. To put another way, the principal components produced by varimax rotation are orthogonal. Third, by selecting items with the significant loading on a single factor is to retain most of the variances explainable by the factor with less number of items. Fourth, creating summated

variable is a process to combine several individual items into a single composite variable. In other words, all of the variable items loading highly on a factor are combined, commonly the average sum of items is used as value for the replacement variable. By summing the highly-loaded items, it creates uni-dimensional composite variables. These composite variables are also referred as latent variables, generally in psychological research field. Since the process to create a composite variable based on highly loaded items, it does not mean that the summated composite variables are uncorrelated. In this study, factor analysis is used as a method to provide information on how new composite variables should be synthesized. By generating composite variables based on factor analysis result, it helps to ensure that highly correlated items are combined into one variable and less correlated items are in different variables. If the new variables (latent variables) conforms to conceptual definition, uni-dimensionality and reliability, then convergent and discriminant validity is ensured (Hair, Black, Babin, & Anderson, 2009). Convergent validity means the conceptually similar measures are correlated and discriminant validity means the conceptually distinct measures are having low correlation. The goal of factor analysis – reducing number of variables in interest is reached through the above-mentioned process.

In the context of this study, EFA is conducted to help identifying the structure of the latent variables. In particular, Principal Component Analysis (PCA) technique is used for exploratory factor analysis. PCA is one of the factor analysis technique that is designed for dimension reduction for large multivariate datasets (Balakrishnan et al., 2014). Despite its apparent use for dimension reduction, PCA also helps reducing multicollinearity and helps identifying any items that are not measuring any constructs, those aspects are very important preparations in multivariate regression analysis (Jolliffe, 2002). In this study, multiple survey items were intended to measure certain self-regulation processes and learning outcomes for which the definition came from the literatures.

Through multiple trials of exploratory factor analysis, it can be observed that items belonging to “post-training self-efficacy” do not load significantly onto principle components nor significantly load onto principle components but are not

interpretable. In detail, referring to Appendix 3, it can be seen that items 1, 2, 3, 6, 7 of post-training self-efficacy are not loading significantly onto principle components and the items 4 and 5 are not loading onto principle components with other items. It breaks the assumption that the principle components are guiding the summation of complex variable, i.e. composing more than one item. Further, examining the meaning of some items, it is noticed that for example item 4 uses the expression “all I need now is practical experience”. This expression is an absolute statement, which may be perceived and interpreted differently with other items in this scale.

Therefore, “post-training self-efficacy” is placed apart from further factor analysis.

Apart from post-training self-efficacy, exploratory factor analysis is reapplied to survey items. The suitability of PCA was assessed prior to analysis. Inspection of the correlation matrix showed that all variables had at least one correlation coefficient greater than 0.3. The overall Kaiser-Meyer-Olkin (KMO) measure is 0.934 with individual KMO measures all greater than 0.7, classifications of 'middling' to 'meritorious' according to Kaiser (1974). Bartlett's test of sphericity is statistically significant ( $p < .0005$ ), indicating significant correlations among variables and that the data is likely factorizable. Factor loading greater than .6 is considered significant. Appendix 4 shows the rotated component matrix, and factor loadings greater than .6 are highlighted in bold. Applying this criterion, the following Table 4-5 is to show the constructing items of each latent variable, each consisting highly loaded items. Common features of constructing items are analyzed to name the latent variables. The meaning of the items were analyzed and verified with Mongolian professors and education practitioners to ensure its validity. Through focus group discussion, it was found that the local primary school teachers believe that the names of the latent variables reflect the learning processes of teachers. Therefore, the latent variables in Table 4-5 are considered to be able to represent teachers' learning motivation and learning strategies in Mongolian teacher development context.

**Table 4-5: Constructing items for latent variables and its naming**

Components	Constructing items	Latent variable
1	Slfef 3: I expect to do well in this teacher training. Intr 3: The most satisfying thing for me in teacher training is trying to understand the content as thoroughly as possible. Slfef 1: I'm confident I can understand the basic concepts taught in teacher training. Tskv 4: I think the materials in teacher training are useful for me to learn. Tskv 3: I am very interested in the content area of the teacher training materials. Intr 2: In teacher training, I prefer the materials that arouses my curiosity, even if it is difficult to learn. Intr 1: In teacher training, I prefer the materials that really challenge me so I can learn new things.	Internal motivation
2	Satisf 5: I will apply the information that I learned in teacher training materials. Intent 1: I intend to apply the skills acquired from the teacher training program. Satisf 3: The content of the teacher training material was presented in a way that helped me to learn. Intent 2: I will continue applying the knowledge acquired in teacher training. Satisf 1: I found the learning experience of teacher training materials to be enjoyable.	Learning satisfaction and intention to apply learning contents
3	Crit 4: I try to play around with ideas of my own related to what I am learning in teacher training. Elab 2: When studying for teacher training, I try to relate the training material to what I already know. Org 4: When I study for teacher training, I go over my notes and make an outline of important concepts. Mcg 6: 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 teacher training. Mcg 4: Before I study new teacher training material thoroughly, I often skim it to see how it is organized.	Planning and organizing skills
4	Crit 5: Whenever I read or hear an assertion or conclusion in the teacher training material, I think about possible alternatives. Elab 4: I try to understand the teacher training materials by making connections between the teacher training guideline and the concepts from the teacher training VCDs (and interactive material). Mcg 7: When studying for teacher training I try to determine which concepts I don't understand well.	Critical and positive thinking skills
5	Crit 1: I often find myself questioning things I hear or read in teacher training to decide if I find them convincing.	
6	Extr 2: If I can, I want to get better assessment in teacher training than most of the other teachers. Extr 1: Getting a good assessment in this training is the most satisfying thing for me right now.	Motivation for better assessment
7	Eff 2: I work hard to do well in teacher training even if I don't like what we are doing. Eff 3: Even when teacher training materials are dull and uninteresting, I manage to keep working until I finish.	Effort regulation
8	Satisf 4: I expect to refer to one or more of the teacher training materials again.	

Note: Component 5 and 8 are excluded for further analysis due to its unreliability to form a latent variable

#### 4.5.3 Step 3: Create latent variables by summing and averaging

The last step is to create the latent variables based on the result of exploratory factor analysis shown in Table 4-5. There are two major considerations of creating latent variables by summing and averaging constructing items as discussed below.

First, summing multiple items to create latent variables is theoretically supported. This study adopts self-regulated learning theory which concerns one's learning motivation and learning strategies. There are several types of learning motivation, such as internal motivation which was identified in the previous step (refer to section 4.5.2). Internal motivation is an underlying concept that cannot be directly measured, instead, perceptions on psychological status such as interest, confidence, and curiosity are used to represent internal motivation.

Second, this study summates multiple Likert type items to create variables in Likert scale, which is a method supported by previous researches in the field. As mentioned by Likert (1932), a Likert scale is made up of multiple items and is subject to parametric analysis. More recently, Carifio and Perla (2007) emphasized that the Likert scale has interval scale properties as it is a composite of items. Moreover, Sullivan (2013) has stated that taking the average of multiple Likert type items is the recommended and widely used approach in studies involving survey data. This study follows the discussion in the literature, assuming the interval scale properties of the latent variables, which are used in further analysis in answering research questions.

However, it should be noted there is the debate on whether Likert scale can be treated as interval data or ordinal data. It is argued that statistics such as means do not provide a meaningful measure of the central tendency of the Likert scale, for example, what does the average of "never" and "rarely" mean? In terms of analyzing Likert data, experts suggested the use of median, frequencies, contingency tables, Chi-squared test, Spearman rho test, and ordinal logistic regression instead of parametric tests. On the other hand, Norman and Gaito agreed that researchers should not make further inferences about the differences in

the underlying, latent, characteristics reflected in the Likert numbers, but it does not invalidate the conclusions about the numbers. Norman (2010) further argues that parametric tests can produce meaningful outcomes. He emphasized the “robustness” of the parametric tests citing previous methodological studies. Norman also compared the Pearson correlation with Spearman correlation matrices on a non-normal, highly skewed 10-point Likert scale data set, and found the result to be identical.

In order to ensure that the constructing items share similar characteristics and the central tendencies of the constructing items are representative, descriptive statistics including median, mean and standard deviation (SD) are used to understand the central tendency and dispersions. Although mean and SD does not relate to a meaningful interpretation, it shows the trend of the data in this study, and allows comparison with medians. The median is the middle score for a question item that the score has been arranged according to its magnitude. The mean is equal to the sum of all the score in an item divided by the number of scores of that item. Standard deviation is a measure of data dispersion around the mean, calculated by taking the square root of variance. The following six numbered sections shows the central tendency of the question items for each latent variable. Please find the corresponding data tables and histograms in Appendix 5. The sub-sections below describe the constructing items of each latent variables based on the descriptive statistics.

#### 1) Internal motivation

Table 13-1 shows the descriptive statistics of the constructing items for the latent variable “internal motivation”. It can be seen that the medians of the items are the same, which is 6. The means of the items range from 5.53 to 6, and standard deviations range from 1.06 to 1.41. These statistics show a relatively close central tendency of these items, suggesting the suitability to combine them into one latent variable.

## 2) Learning satisfaction and intention to apply learning contents

Table 13-2 shows the descriptive statistics of the constructing items for the latent variable “learning satisfaction and intention to apply learning contents”. It can be seen that the medians of the items are the same, which is 6. The means of the items range from 5.8 to 6.05, and standard deviations range from 1 to 1.23. These statistics show a relatively close central tendency of these items, suggesting the suitability to combine them into one latent variable.

## 3) Planning and organizing skills

Table 13-3 shows the descriptive statistics of the constructing items for the latent variable “planning and organizing skills”. It can be seen that the medians of the items are the same, which is 6. The means of the items range from 5.38 to 5.81, and standard deviations range from 1.14 to 1.34. These statistics show a relatively close central tendency of these items, suggesting the suitability to combine them into one latent variable.

## 4) Critical and positive thinking skills

Table 13-4 shows the descriptive statistics of the constructing items for the latent variable “critical and positive thinking skills”. It can be seen that the medians of the items are the same, which is 6. The means of the items range from 5.45 to 5.49, and standard deviations range from 1.19 to 1.31. These statistics show a relatively close central tendency of these items, suggesting the suitability to combine them into one latent variable.

## 5) Motivation for better assessment

Table 13-5 shows the descriptive statistics of the constructing items for the latent variable “motivation for better assessment”. It can be seen that the medians of the items are the same, which is 5. The means of the items range from 5.02 to 5.03, and standard deviations range from 1.45 to 1.67. These statistics show a relatively close central tendency of these items, suggesting the suitability to combine them into one latent variable.

6) Effort regulation

Table 13-6 shows the descriptive statistics of the constructing items for the latent variable “effort regulation”. It can be seen that the medians of the items are the same, which is 5. The means of the items are the same, which is 5.12. The standard deviations are the same, which is 1.59. These statistics show a close central tendency of these items, suggesting the suitability to combine them into one latent variable.

In summary, the descriptive analyses confirm that central tendencies are close regarding the constructing items for each of the six latent variables. These findings serve as the basis for the summation and average of the items to construct latent variables.

To further ensure reliability, the constructing items for latent variables in Table 4-5 went through the reliability analysis to confirm its group reliability. Table 4-6 shows the result of the reliability analysis.

**Table 4-6: Reliability analysis of latent variables**

Principal Component	Latent variable	Cronbach’s Alpha
1	Internal motivation	.876
2	Learning satisfaction	.907
3	Planning and organizing skills	.890
4	Critical and positive thinking skills	.810
6	Motivation for better assessment	.700
7	Effort regulation	.698

As observed from Table 4-6, all latent variables summated based on factor analysis result are internally consistent according to the Cronbach’s Alpha for each component. These six latent variables that are used to construct research questions and hypotheses, which are discussed in the next section 4.6.

## 4.6 Research questions and hypothesis

### 4.6.1 Overview

Table 4-7 gives the overview of the three research questions in this study, and the corresponding test method, and hypotheses. The details of the test methods and the hypotheses are discussed in the following sub-sections.

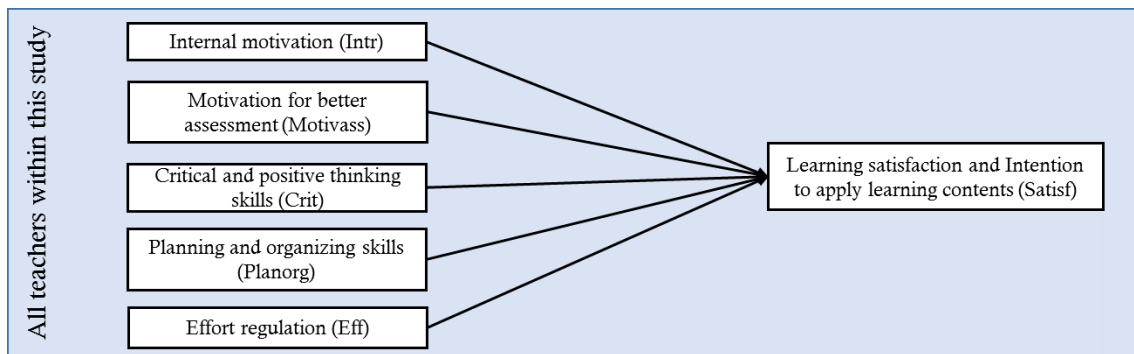
**Table 4-7: Overview of research questions, test method, and hypotheses**

Research question (RQ)	Test method	Hypotheses
RQ1: What are the factors among internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, and effort regulation that affect learning satisfaction and intention to apply learning contents?	Multiple linear regression analysis	None
RQ2: Are there any differences in internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, effort regulation, and learning satisfaction and intention to apply learning contents between those who used interactive teacher training materials and those who do not?	T-test and Mann-Whitney U-test	6 hypotheses: hypothesis 2.1 – hypothesis 2.6 (refer to 4.6.3 for details)
RQ3: Does the use of interactive materials affect the relationship between learning satisfaction and intention to apply learning contents with internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, as well as effort regulation?	Moderated multiple linear regression	5 hypotheses: hypothesis 3.1 – hypothesis 3.5 (refer to 4.6.3 for details)

#### 4.6.2 Research questions

Based on theoretical framework and research objectives, three research questions (RQs) are constructed reflecting the factor analysis result. Research question 1 is formulated under the first research objective: identify important self-regulation processes that affect teachers' learning outcome.

Research question 1: What are the factors among internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, and effort regulation that affect learning satisfaction and intention to apply learning contents?



**Figure 4-3: Research framework for RQ1**

Research question 2 and 3 are formulated under the second research objective: find out the influence of interactive materials on teachers' learning in self-development based on self-regulated learning (SRL) theory.

Research question 2: Are there any differences in internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, effort regulation, and learning satisfaction and intention to apply learning contents between those who used interactive teacher training materials and those who do not?

Research question 3: Does the use of interactive materials affect the relationship between learning satisfaction and intention to apply learning contents with internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, as well as effort regulation?

#### 4.6.3 Hypotheses

The following hypotheses are created for research question 2, hypothesizing the positive influence of interactive materials on teacher's self-regulation processes and learning outcome.

Hypothesis 2.1: Teachers who utilize interactive teacher training materials perceive higher internal motivation than those who do not (Carneiro et al., 2011; Domagk et al., 2010; Kennedy, 2004).

Hypothesis 2.2: Teachers who utilize interactive teacher training materials perceive higher motivation for better assessment than those who do not (Kang & Tan, 2014; Law et al., 2010; Selvi, 2010).

Hypothesis 2.3: Teachers who utilize interactive teacher training materials perceive higher use of critical and positive thinking skills than those who do not (Gharib, Zolfaghari, Mojtahedzadeh, Mohammadi, & Gharib, 2016; Haghparast, Nasaruddin, & Abdullah, 2014).

Hypothesis 2.4: Teachers who utilize interactive teacher training materials perceive higher use of planning and organizing skills than those who do not (Delen, Liew, & Willson, 2014; Johnson, Gueutal, & Falbe, 2009; Kennedy, 2004).

Hypothesis 2.5: Teachers who utilize interactive teacher training materials perceive higher effort regulation than those who do not (Nada Dabbagh, Dabbagh, & Kitsantas, 2004; Rakes & Dunn, 2010).

Hypothesis 2.6: Teachers who utilize interactive teacher training materials perceive higher learning satisfaction and intention to apply learning contents (Violante & Vezzetti, 2015).

The following hypotheses are created for research question 3, hypothesizing the positive influence of interactive materials on the relationship between self-regulation processes and learning outcome.

Hypothesis 3.1: Internal motivation has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials (Carneiro et al., 2011).

Hypothesis 3.2: Motivation for better assessment has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials (Cheng, 2014).

Hypothesis 3.3: Planning and organizing skills have stronger influences on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials (Delen et al., 2014).

Hypothesis 3.4: Critical and positive thinking skills have stronger influences on learning satisfaction and intention to apply learning contents when teachers who utilize interactive materials (Gharib et al., 2016).

Hypothesis 3.5: Effort regulation has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials (Rakes & Dunn, 2010).

#### 4.7 Data analysis procedure

##### 4.7.1 Multiple linear regression analysis

To answer research question 1 “What are the factors among internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, and effort regulation that affect intention to apply learning contents?”, multiple linear regression analysis was employed. Multiple linear regression analysis has been accepted as the general system for analyzing data in behavioral sciences. It is used when dependent variable is to be studied as a function of or with relationships to any other factors of interest, namely independent variables (Cohen, Cohen, West, & Aiken, 1975). In this study, it is utilized to analyze the relationships between the Self-regulation processes and the learning outcome in the context of self-development of in-service teacher training. The general model for multiple linear regression is shown in Equation 1.

$$y = b_0 + b_1x_1 + b_2x_2 + \dots + b_nx_n \quad (1)$$

Equation 1 shows the model with coefficient estimation using the least squared method, where  $b_0$  is the estimated intercept and  $b_1 \dots b_n$  to be the regression coefficient of each independent variable. The coefficients of the best-fitting line are calculated by minimizing the sum of the squared errors ( $SS_E$ ) of the vertical deviations from each data point to the line. In extreme case, if a point lies on the fitted line exactly, then its vertical deviation is 0. Least squared method is the core concept of fitting the regression line, where the sum of the squared errors is minimalized.

The interpretation of the regression model coefficients has the focus on three values: regression coefficient, intercept, and the coefficient of determination (total variance explained). Regression coefficient quantifies the estimated change in the dependent variable for a unit change in the independent variable. Intercept has explanatory value only within the range of values of independent variable (Hair et al., 2009). In other term, the value of intercept is only interpretable if zero is a conceptually valid value for independent variables. That means, if independent variables represent the measure that cannot have a true value of zero, such as perceptions, the intercept can only be interpreted within the mathematical modelling context but not having explanatory value. The coefficient of determination ( $R^2$ ) is calculated as the squared correlation between the actual and predicted values of the dependent variable, which represents the combined effects of all independent variables in explaining the dependent variable. In other words, it shows the total variance in dependent variable that is explained by the independent variables.

There are four important assumptions of multiple linear regression analysis to be fulfilled. It is necessary to test several aspects of the statistical model from the multiple regression analysis in order to meet all assumptions of the analysis, only by meeting multiple criteria can the regression model become valid. First of all, there should be a linear relationship between all independent variables and dependent variable in the study for general linear multiple regression analysis, the relationship can be observed by the plots between each independent variable and dependent

variable (Osborne & Waters, 2002). Second, data is assumed to be homoscedastic (same standard deviation for different groups), one method to check homoscedasticity of data is to plot studentized residues against unstandardized predicted value and observe if the residues are equally spread over the predicted value (Nobre & da Motta Singer, 2007). Third, the existence of multicollinearity is checked among the independent variables. A valid regression model should have no independent variable that are highly correlated to each other, i.e. having multicollinearity. A common rule of thumb is to reduce multicollinearity by eliminating one or two independent variables that have the Variance Inflation Factor (VIF) value greater or equal to 10 (Belsley, Kuh, & Welsch, 2005). Fourth, the residues in regression need to be normally distributed and this can be examined by the plot of standardized residue or the normal P-P plot of the standardized residue (Osborne & Waters, 2002). The validity of the multiple linear regression model is ensured by examining and ensuring the above mentioned four criteria.

#### 4.7.2 T-test and Wilcoxon rank-sum test (Mann-Whitney U-test)

To answer research question 2 “Are there any differences in internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, effort regulation, and learning satisfaction and intention to apply learning contents between those who used interactive teacher training materials and those who do not?”, this study employed two ways to compare means or to detect if there is a significant difference between two groups. The first is independent samples t-test, and the second is the Mann-Whitney U test. The following paragraphs explain these two methods and discusses the reason to employ these two methods.

Independent samples t-test is used to determine if a difference exists between the means of two independent groups on a continuous dependent variable. More specifically, it helps to determine whether the difference between these two groups is statistically significant. This test is also known by a number of different names, including the independent t-test, independent-measures t-test, between-subjects t-test, unpaired t-test and Student's t-test. In this study context, t-test is utilized to

detect if there are any differences in two teacher groups where each group receives different intervention. Group A refers to teachers conducting self-development with interactive and traditional materials, whereas Group B refers to teachers conducting self-development with traditional materials only. Assuming similar learning conditions for both groups, the dependent variables of interest, explicitly the self-regulation processes and learning outcome are measured at the end of the intervention through the questionnaire developed. Independent samples t-test tests the null hypothesis ( $H_0$ ) and alternative hypothesis ( $H_1$ ) as shown below.

$$H_0: \mu_1 = \mu_2 \text{ (means of two groups are equal)}$$

$$H_1: \mu_1 \neq \mu_2 \text{ (means of two groups are not equal)}$$

Null hypothesis is rejected when the significance test shows  $p < .05$ . In this case, alternative hypothesis is accepted which states that the means of the two groups are not equal. To select the valid t-test result for interpretation, the Levene's test for equality of variances should also be investigated. Levene's test is also a hypothesis test as shown below.

$$H_0: \sigma_1^2 = \sigma_2^2 \text{ (the group variances are equal)}$$

$$H_1: \sigma_1^2 \neq \sigma_2^2 \text{ (the group variances are not equal)}$$

Null hypothesis is rejected when the significance test shows  $p < .05$ . In this case, equal variances of the groups cannot be assumed. Therefore, the Welch t-test result should be used for interpretation. In the opposite, the normal t-test result should be interpreted if null hypothesis is accepted. Fortunately, common statistics package such as SPSS provides both types of t-tests for easier interpretation.

Similar to other statistical analysis, t-test also comes with several assumptions: 1) dependent variable is continuous, 2) the independent variable is dichotomous or binary, 3) independence of observations, 4) no extreme outliers, 5) dependent variable should be normally distributed. It is often the case that the dependent variable is not normally distributed, and sometimes highly skewed. Two potential solutions are discussed here. The first one is to use a non-parametric test instead, such as the Mann-Whitney U test, which will be discussed afterwards. The second

is to carry on with the t-test regardless of the violation of normality. According to the literature discussing the principle of normality (Diehr & Lumley, 2002; Toby Mordkoff, 2016), if the sample sizes in both groups are equal, or nearly equal, only strong violations of normality might actually cause problems. Indeed, if sample sizes are not small, even fairly skewed distributions – as long as the groups are similarly skewed – are not always problematic. In conclusion, non-normality does not affect Type I error rate substantially and the independent-samples t-test can be considered robust.

The following paragraphs discuss the alternative method to t-test when the dependent variable is highly skewed. This method is the Wilcoxon rank-sum test or the Mann-Whitney U test. These two tests, essentially having the same mathematical principles behind them, are often presented as the non-parametric alternatives to the independent samples t-test. These tests can be used when the assumptions (such as normality) of the independent-samples t-test are violated. Wilcoxon rank-sum test works by giving ranks to the values of a variable that is subject to comparison between two groups. First, all the response values of the samples for two groups are lined up from lowest to highest. Then, a potential rank is assigned to all values, from rank 1 to the last rank which corresponds with the highest response value. For a response value that appears more than one time, an actual rank is calculated by averaging the ranks. After that, an actual rank is calculated by summing the rank values of each group. As a result, a test static ( $W_s$ ) is calculated and enters a significance test to determine whether there is a significant difference between two groups. This method tests the hypothesis regarding the distribution (shapes) of the two groups as below.

$H_0$ : the distribution of scores for the two groups are equal

$H_A$ : the distribution of scores for the two groups are not equal

By rejecting the null hypothesis, it can be concluded that the distribution of the dependent variable for two groups are not equal, which means that the dependent variable measured by mean rank is not the same.

### 4.7.3 Moderated multiple linear regression

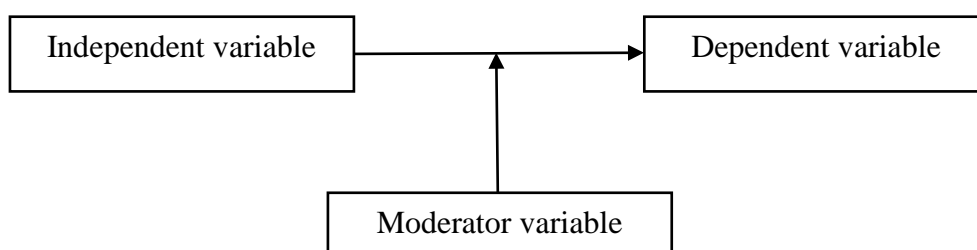
To answer research question 3, the moderated multiple linear regression was utilized. The following sections explain 1) the background of moderation analysis, 2) analysis model with multiple independent variables, 3) analysis model with more than one moderator, and 4) previous studies applying moderation analysis.

#### 1) Background of moderation and statistical interaction

Moderation analysis or referred as moderated multiple regression is an extension of a multiple regression analysis that includes an additional independent variable carrying the information regarding moderating effect (the effect to the relationship between other independent variables and dependent variable) (Aguinis, 2003, p. 20).

Moderation analysis is utilized to answer “when” questions, identifying a moderator of an effect (effect of an independent variable to dependent variable) helps to establish the circumstances, stimuli, or type of people for which the effect is large versus small, present versus absent, positive versus negative, and so forth (Hayes, 2013, p. 208).

Moderation analysis can be described in a figure as:



**Figure 4-4: Conceptual model of moderation analysis**

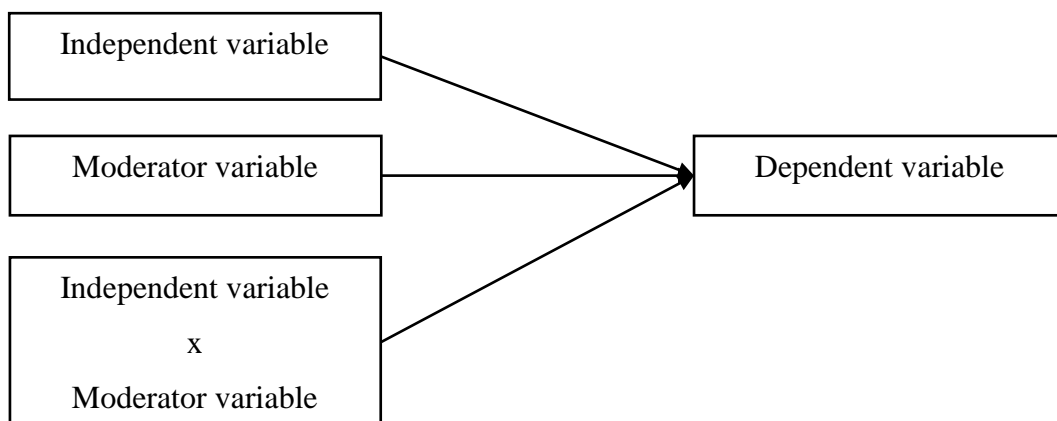
Source: Aguinis, 2003, p. 5

As can be observed from Figure 4-4, moderator variable is not pointing towards dependent variable. This does not mean that moderator variable is not an independent variable in a moderation model. The conceptual model of a moderation model is very different from its corresponding statistical diagram,

which represents how such moderation model is analyzed in the form of an equation (Figure 4-5).

An interaction effect is said to exist when the effect of the independent variable on the dependent variable differs depending on the value of a third variable, called the moderator variable (Jaccard & Turrisi, 2003). A moderation analysis is to test the hypothesis that the effect of an independent variable on a dependent variable depends on the value of a moderator variable.

One method to determine if a moderator effect exists is to use an interaction term in a multiple regression analysis. An interaction term is created by multiplying the independent and moderator variable. This is then added to the regression model to predict the dependent variable, as illustrated below:



**Figure 4-5: Statistical model for moderation analysis**

Source: Aguinis, 2003, p. 13

Figure 4-5 shows the statistical model of the simplest form of moderation analysis which consists three terms in the regression model to predict the dependent variable: the independent variable, the moderator variable and an interaction term. To determine if the moderation effect is in place, it is necessary to test the interaction term for statistical significance. If the interaction term is statistically significant, there is a moderator effect.

For moderation models, if the term “independent variable x moderator variable” is retained in the model, independent variable and moderator variable must be included as well, even if their coefficients are not statistically significant (Hayes,

2013, p. 219). Excluding either independent variable or moderator variable will bias the estimation of the moderation of independent variable's effect to dependent variable by the moderator variable.

The statistical model for moderation analysis shown in Figure 4-5 can be written in the equation below, giving independent variable notation "X", moderator variable "M" and dependent variable "Y".

$$Y = i_1 + f(M)X + b_2M \quad (1)$$

Where  $f(M)$  is a function of  $M$ ,  $f(M) = b_1 + b_3M$ . As can be seen,  $f(M)$  is the coefficient of  $X$ , therefore  $M$  is affecting  $X$ 's effect on  $Y$ . Substituting into the equation (1) gives the following result.

$$Y = i_1 + (b_1 + b_3M)X + b_2M \quad (2)$$

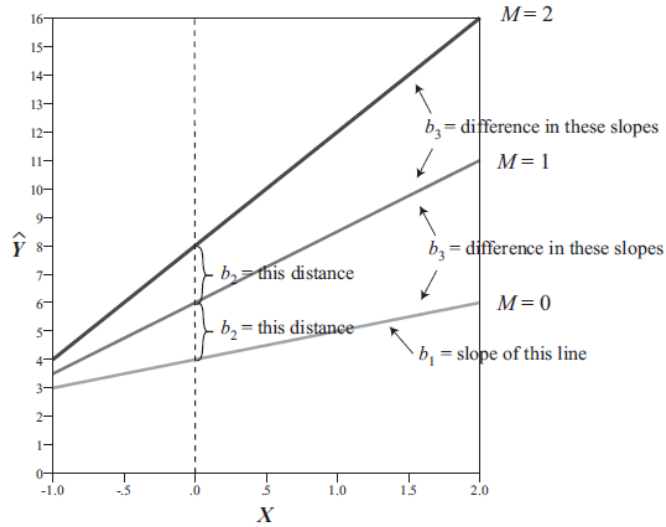
Expanding equation (2) gives:

$$Y = i_1 + b_1 X + b_3MX + b_2M \quad (3)$$

Rearranging the order:

$$Y = i_1 + b_1 X + b_2M + b_3MX \quad (4)$$

Equation (4) is a mathematical representation of Figure 4-6. The interpretation of the coefficients is different from that of multiple linear regression. First,  $b_1$  represents the association between  $X$  and  $Y$  conditioned on  $M = 0$ . Second,  $b_2$  represents the association between  $M$  and  $Y$  conditioned on  $X = 0$ . Third,  $b_3$  represents how much the difference in  $Y$  changes between two cases that differ by a unit on  $X$  as  $M$  changes by one unit. In other words,  $b_3$  estimates the difference in slopes of  $X$  and  $Y$  between one unit change in  $M$  (Figure 4-6).



**Figure 4-6: Visual representation of coefficients in moderation model**

Source: Hayes, 2013, p. 218

2) Multiple independent variables

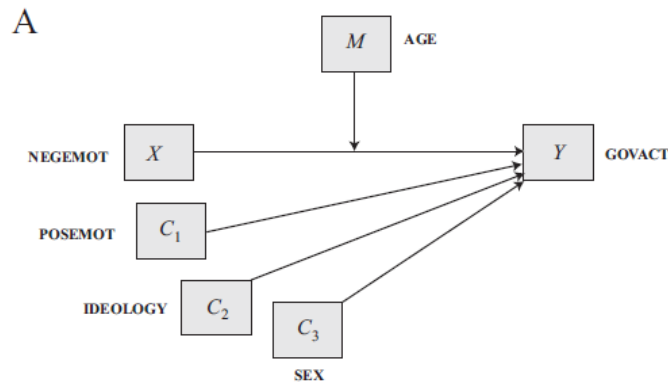
Hayes introduced a research context where multiple independent variables exist (Hayes, 2013). This section introduces a specific example to illustrate how moderated multiple linear regression is used in a study with multiple independent variables.

The purpose of the research is to examine the influence of age to the effect of negative emotions towards climate change (independent variable) on support for government action (dependent variable). The model controls political ideology, sex, and positive emotions. Given negative emotions “X”, age “M”, positive emotions “C<sub>1</sub>”, ideology “C<sub>2</sub>”, sex “C<sub>3</sub>”, the moderation model can be written as:

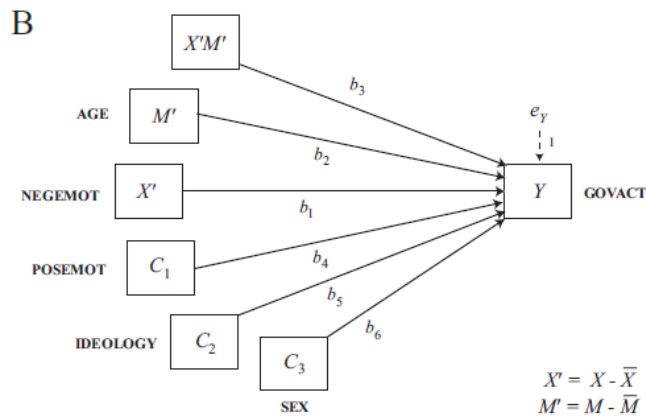
$$Y = i_1 + b_1X + b_2M + b_3XM + b_4C_1 + b_5C_2 + b_6C_3 \quad (5)$$

The coefficient of X,  $b_1$  can be interpreted when  $M = 0$ , but age (M) cannot be 0 in this research data, therefore, the author rearranged the model by mean centering X and M. This means  $b_1$  can be interpreted when  $M = \text{Average } M$ . The mean centered X and M are written as  $X'$  and  $M'$ , resulting the following equation:

$$Y = i_1 + b_1X' + b_2M' + b_3X'M' + b_4C_1 + b_5C_2 + b_6C_3 \quad (6)$$



**Figure 4-7: Conceptual diagram for the moderation of negative emotions about climate change on support for government action by age with various covariates**  
 Source: (Hayes, 2013, p. 256)



**Figure 4-8: Statistical diagram for the moderation of negative emotions about climate change on support for government action by age with various covariates**

Source: Hayes, 2013, p. 256

The regression analysis gives the following result:

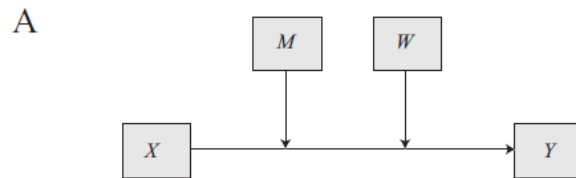
$$Y = 5.532 + 0.433X' + 0.006X'M' - 0.212C_2 \quad (7)$$

To review,  $X'$  is negative emotions (mean centered),  $M'$  is age (mean centered), and  $C_2$  is ideology. The result shows that the coefficient for moderation term (0.006) is statistically significant. This means that the effect of negative emotions on support for government action depends on age, older the age, stronger the effect of negative emotions on support for government action. Further, among people with average age but equal in other factors, one-unit difference in negative emotions will result in 0.433 units difference in support for government action. Finally, holding all other factors constant, those who are more politically

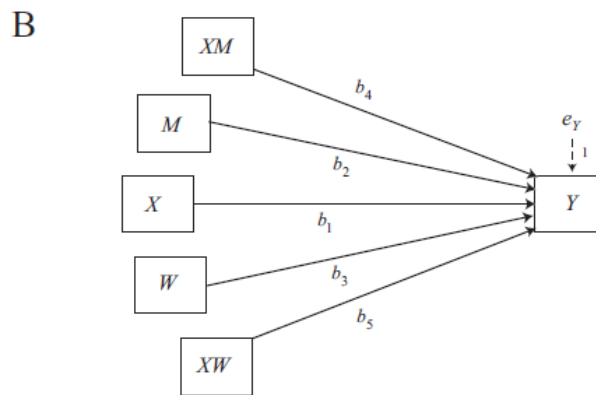
conservative are less supportive of government action to mitigate global climate change. That means if a person perceives higher conservative ideology by 1 unit, he is less supportive of government action to mitigate global climate change by 0.212 units.

3) More than one moderator

Hayes's book introduces a situation where there are multiple moderators, specifically two moderators in his example. The conceptual and statistics diagrams are shown below.



**Figure 4-9: Conceptual diagram of moderation with 2 moderators**  
Source: (Hayes, 2013, p. 303)



**Figure 4-10: Statistical diagram of moderation with 2 moderators**  
Source: Hayes, 2013, p. 303

The equation representing moderated relationship two moderators is written as follows:

$$Y = i_1 + f(M, W)X + b_2M + b_3W \quad (8)$$

Substituting  $f(M, W) = b_1 + b_4M + b_5W$  gives:

$$Y = i_1 + (b_1 + b_4M + b_5W)X + b_2M + b_3W \quad (9)$$

Expanding the equations results in:

$$Y = i_1 + b_2M + b_3W + b_1X + b_4MX + b_5WX \quad (10)$$

In this model, X's effect on Y is estimated as a function of M and W, as shown in equation 9. The interpretation of the regression coefficients are as follows. For  $b_1$ , it indicates X's effect on Y when two moderators, M and W, are 0. Coefficient  $b_4$  quantifies how much the conditional effect of X on Y changes as M changes by 1 unit, holding W constant. Coefficient  $b_5$  quantifies how much the conditional effect of X on Y changes as W changes by 1 unit, holding M constant.

The reason to lay out the equation and coefficient interpretation of a model with more than one moderator here is to introduce to the discussion on the next section, the feasibility of establishing a moderation model with more than one independent variables.

#### 4) Application of moderation in previous studies

The concept of moderation and statistical interaction emerged and developed since 1970s, which was initially used in medical and behavioral science research such as in to investigate the function of different types of yardstick to pathogen and plant disease (Cohen et al., 1975; Rothman, Greenland, & Walker, 1980).

Jaccard gives an example where a researcher is interested in deciding if a clinical treatment for depression is more effective for males than females, then it is clear that gender is the moderator variable and the presence versus absence of the treatment is the independent variable (Jaccard & Turrisi, 2003).

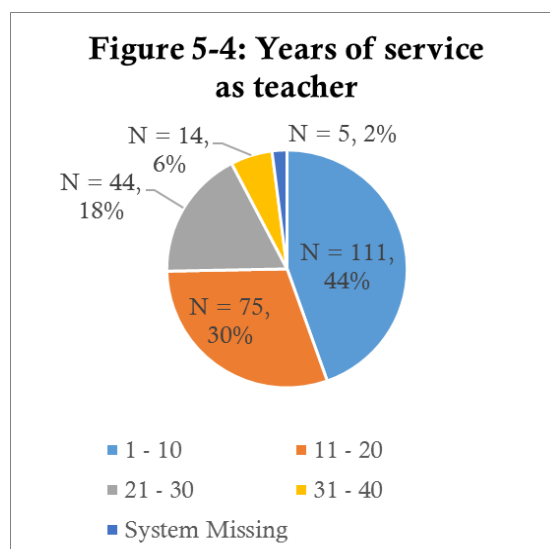
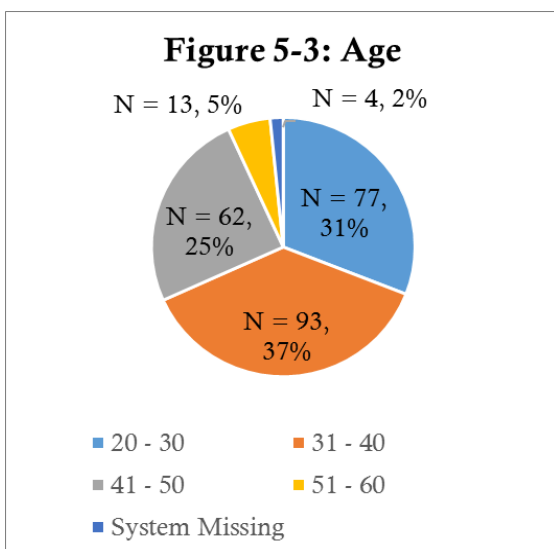
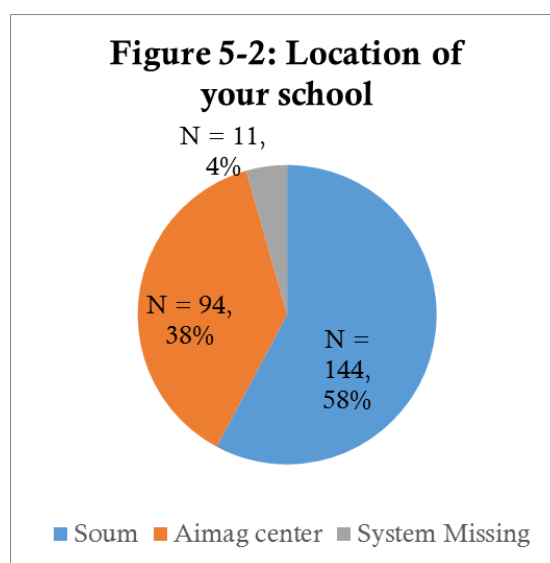
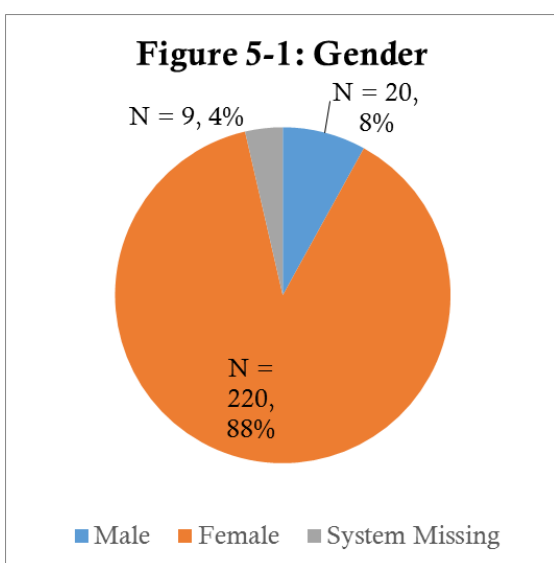
Later on, moderation analysis has also become a practical method to solve research questions in the general discipline of social sciences. For example in organizational behavior discipline, Somers conducted a study on how sunk costs affect the relationship between affective commitment and the relevant outcome variables (e.g. withdrawal intentions, turnover etc.) (Somers, 1995). For another example, Jaccard shows the case in educational discipline to investigate the effect of the number of years of education on income and whether it depends on one's ethnicity (Jaccard & Turrisi, 2003).

This research aims to understand the influence of interactive materials on the relationship between teachers' self-regulation processes and learning outcome in Mongolia. Given the statistical background of moderated multiple linear regression, and the wide application in multiple social research fields, this study applies the moderation analysis to address the research aim.

## Chapter 5: Data analysis

### 5.1 Descriptive analysis

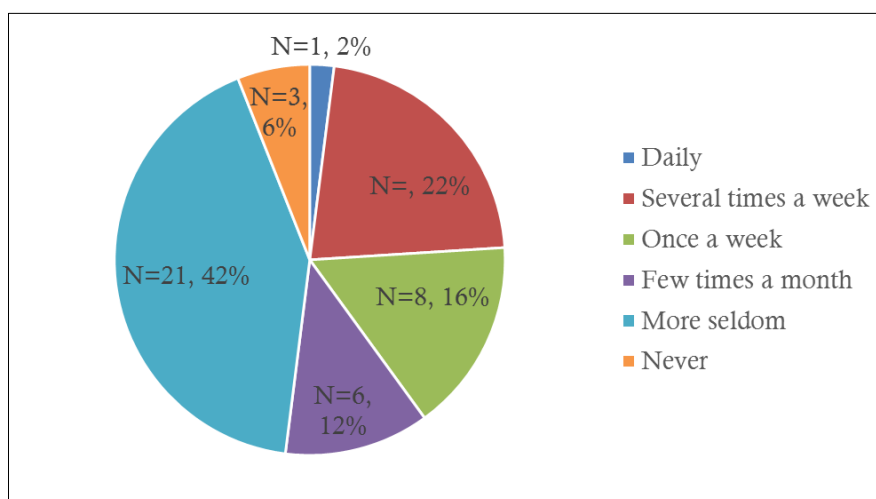
There are 305 number of primary school teachers in Bayankhongor province (Mongolian Government Statistics, 2016). In total, there are 285 survey questionnaires distributed to the Bayankhongor primary school teachers, which covers 93.4% of the primary school teacher in the province. Among the questionnaire distributed, 257 were returned, yielding 90.2% return rate. Through data cleaning, 249 responses are considered valid for the data analysis.



Source: survey data

Descriptive analysis illustrates four characteristics of the sample: 1) gender, 2) location of school, 3) age, and 4) years of service as teacher. In terms of gender, it is clear that the majority of respondents are female (N = 220, 88%) with 20 males (N = 20, 8%). For location of the school, more than half of the respondents come from soum (village) schools (N = 144, 58%), 94 (38%) are from aimag center schools plus 11 respondents not responding to this question. In terms of age, the majority are aged between 20 – 30 (N = 77, 31%) and 31- 40 (N = 93, 37%), with only 6% difference between the two. A quarter of the respondents are aged between 41 – 50 (N = 62, 25%), with only 13 (5%) respondents aged between 51 – 60. For the years of service as teacher, nearly half (N = 111, 44%) of the respondents have 10 – 20 years of experience as teacher. Around one-third (N = 75, 30%) of respondents have served as teacher for 21 – 30 years. Less than one-fifth (N = 44, 18%) have experience as teacher between 31 – 40 years. A few (N = 14, 6%) have served as teacher more than 41 years.

In terms of the frequency in using interactive materials, it can be seen from Figure 5-5 that approximately 50% of the teachers utilize interactive materials at least once a week or more frequently. 47% use interactive materials few times a month, or less. Only less than 3% of teachers never utilized it. The data shows that the majority (97%) of the teachers have utilized interactive materials.



**Figure 5-5: How often teachers use interactive materials**

## 5.2 RQ1: Result of multiple linear regression analysis

In answering research question one “What are the factors among internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, and effort regulation that affect intention to apply learning contents?”, six independent variables and one dependent variable are included in the model. The six independent variables contain five continuous variables: 1) internal motivation (Intr), 2) motivation for better assessment (Motivass), 3) critical and positive thinking skills (Crit), 4) planning and organizing skills (Plaorg), 5) effort regulation (Eff). The five continuous independent variables are latent variables produced based on the exploratory factor analysis result. As for the dependent variable, learning satisfaction and intention to apply learning contents (Satisf) is placed.

This multiple regression model can be expressed using the equation below.

$$\text{Satisf} = b_0 + b_1\text{Intr} + b_2\text{Motivass} + b_3\text{Planorg} + b_4\text{Crit} + b_5\text{Eff} \quad (5.1)$$

The performance of multiple linear regression yields regression coefficients shown in Table 5-1. The significance test shows that three independent variables, 1) internal motivation, 2) planning and organizing skills, and 3) critical and positive thinking skills are statistically significantly affecting the dependent variable, learning satisfaction and intention to apply learning contents, significant at  $p < 0.0005$ . The collinearity statistics show that no collinearity issues exist in this model, with tolerance value  $> 0.1$  ( $\text{VIF} < 10$ ).

**Table 5-1: Regression coefficients and collinearity statistics for RQ1**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	1.189	.309		3.851	.000		
Internal motivation	.391	.072	.372	5.417	.000	.452	2.215
Motivation for better assessment	-.051	.038	-.072	-1.355	.177	.751	1.332
Planning and organizing skills	.243	.063	.255	3.837	.000	.482	2.076
Critical and positive thinking skills	.267	.068	.264	3.912	.000	.466	2.145
Effort regulation	-.025	.035	-.036	-.711	.478	.814	1.228

Based on the regression model and the regression result, the regression coefficients in equation 5.1 can be substituted with the estimated coefficients, as shown in equation 5.2.

$$\text{Satisf} = 1.189 + 0.391\text{Intr} + 0.243\text{Planorg} + 0.267\text{Crit} \quad (5.2)$$

The equation 5.2 above explains that for teachers perceiving higher internal motivation by 1 scale score, their perceptions on learning satisfaction increases by 0.399 scale score. Furthermore, if teachers perceive higher use of critical and positive thinking skills by 1 scale score, their perceptions on learning satisfaction increases by 0.194 scale score. Similarly, if teachers perceive higher use of planning and organizing skills by 1 scale score, their perceptions on learning satisfaction increases by 0.2795 scale score.

Table 5-2 shows the adjusted  $R^2$  of 0.530 which means that 53% of the variance in teacher's learning satisfaction is explained by three factors, namely, internal motivation (Intr), critical and positive thinking skills (Crit), and planning and organizing skills (Mcg). The model does not show autocorrelation as demonstrated by Durbin-Watson at 1.968.

**Table 5-2: Model Summary<sup>b</sup> for RQ1**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.735 <sup>a</sup>	.541	.530	.6657133	.541	50.883	5	216	.000	1.968

a. Predictors: (Constant), Effort regulation, Motivation for better assessment, Critical and positive thinking skills, Planning and organizing skills, Internal motivation

b. Dependent Variable: Learning satisfaction and intention to apply learning contents

Table 5-3 shows the test result for the significance of the model. The F-test yielded the result that  $F(5, 221) = 50.883$ ,  $p < .0005$ . This means that the null hypothesis that all regression coefficients equal to zero is rejected. In this study context, it means that the relationship between three affecting factors and teacher’s learning satisfaction is statistically significant.

**Table 5-3: ANOVA<sup>a</sup> for RQ1**

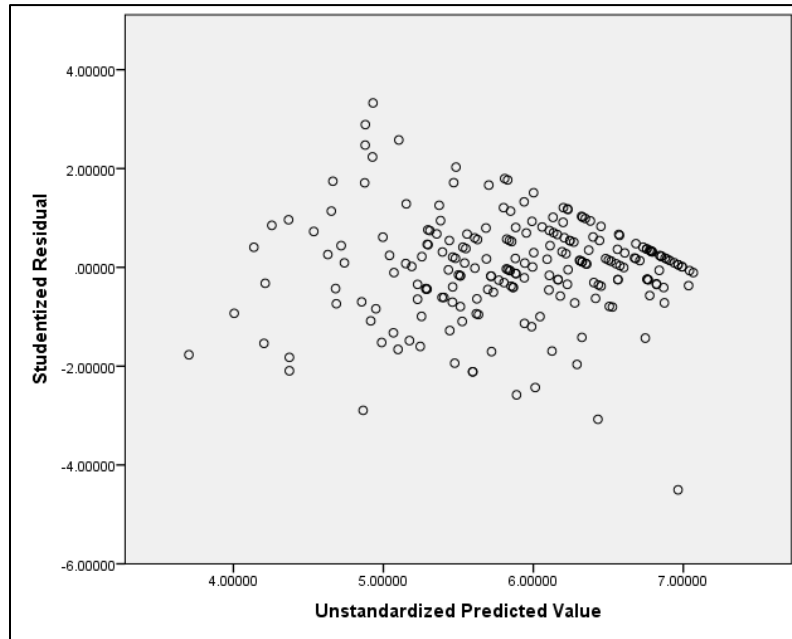
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	112.749	5	22.550	50.883	.000 <sup>b</sup>
	Residual	95.726	216	.443		
	Total	208.475	221			

a. Dependent Variable: Learning satisfaction and intention to apply learning contents

b. Predictors: (Constant), Effort regulation, Motivation for better assessment, Critical and positive thinking skills, Planning and organizing skills, Internal motivation

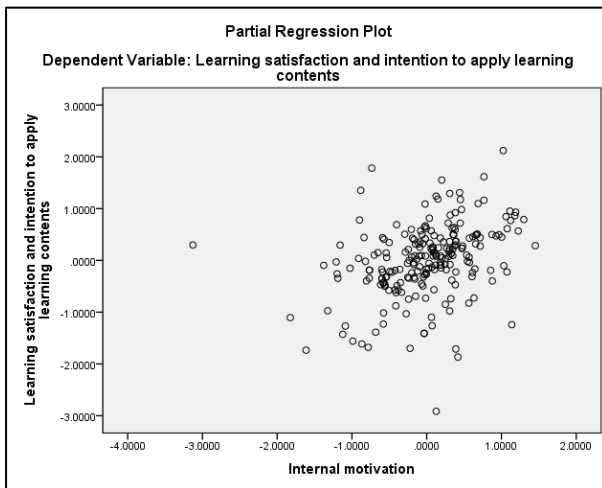
### 5.2.1 Assumptions of the model for RQ1

Figure 5-6 shows the plot of studentized residues to the unstandardized predicted value of the regression model for RQ1. This graph is used to see if a linear relationship exists between the dependent and independent variables collectively, and to see the homoscedasticity of the model. As shown in the figure, the residues generally form a horizontal band, demonstrating the linear relationship between the dependent and independent variables collectively. Further, there is homoscedasticity of the model as the residues are relatively evenly spread.

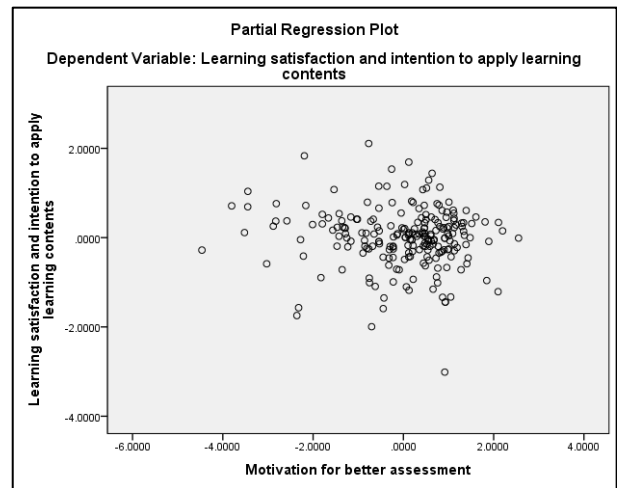


**Figure 5-6: Plot of residual to predicted value for the model of RQ1**

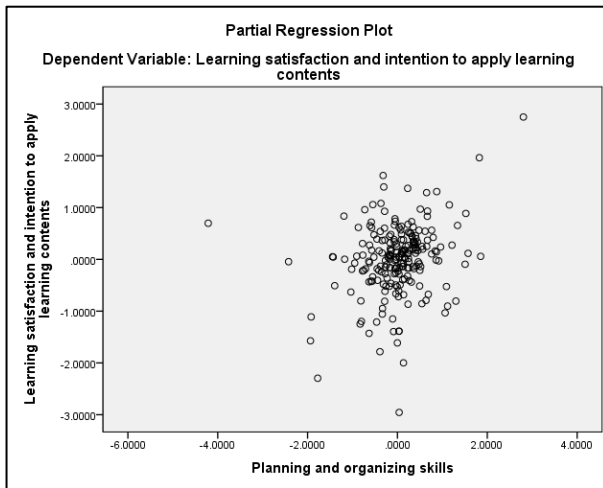
The examination of partial regression plots (Figure 5-7 to Figure 5-11) shows to a degree of the linear relationships between learning satisfaction and five self-regulation processes, and no strong violation of linearity of each independent variable is observed.



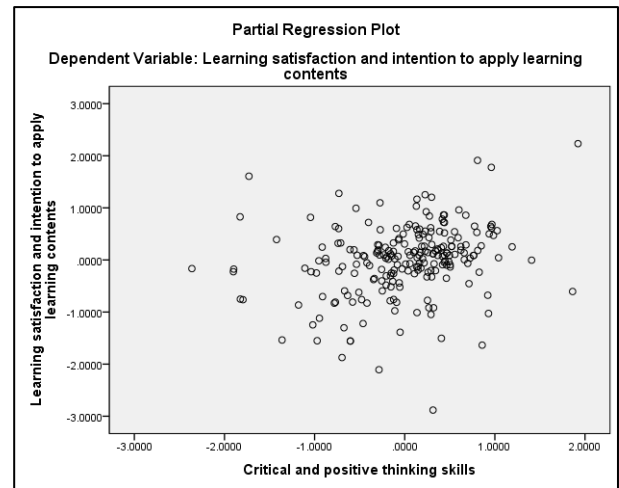
**Figure 5-8: Plot of learning satisfaction to internal motivation for RQ1**



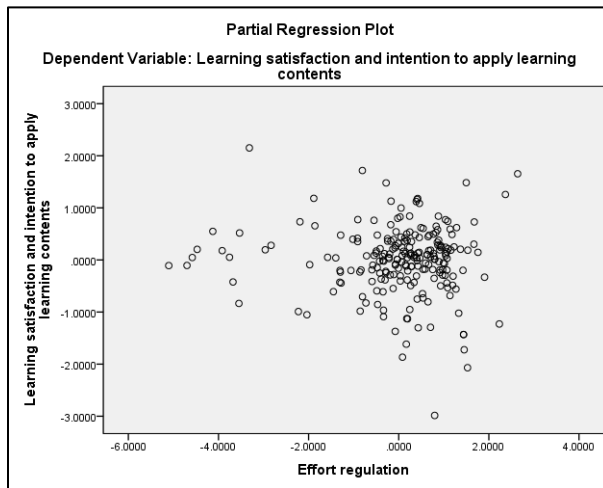
**Figure 5-7: Plot of learning satisfaction to motivation for better assessment for RQ1**



**Figure 5-9: Plot of learning satisfaction to planning and organizing skills for RQ1**



**Figure 5-10: Plot of learning satisfaction to critical and positive thinking skills for RQ1**



**Figure 5-11: Plot of learning satisfaction to effort regulation for RQ1**

It can be seen from Figure 5-12 that the points are relatively aligned to the line, without severe deviations. This indicates that the residuals are close to normal. Further, Figure 5-13 shows that the mean of the residuals is close to zero, and standard deviation is close to 1. Together with the examination of the shape of histogram, it can be seen that the residuals are normally distributed.

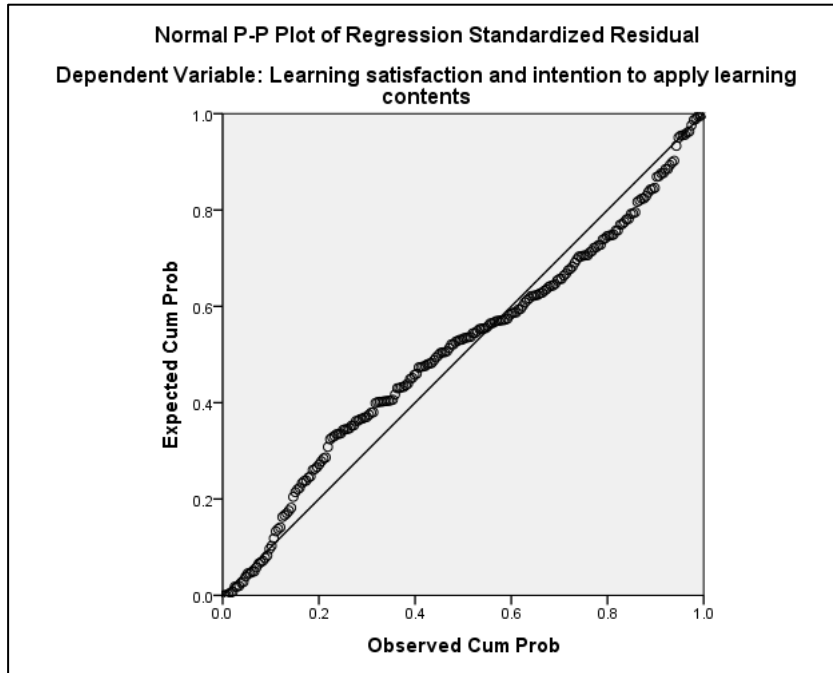


Figure 5-12: Normal P-P plot of regression standardized residual for the model of RQ1

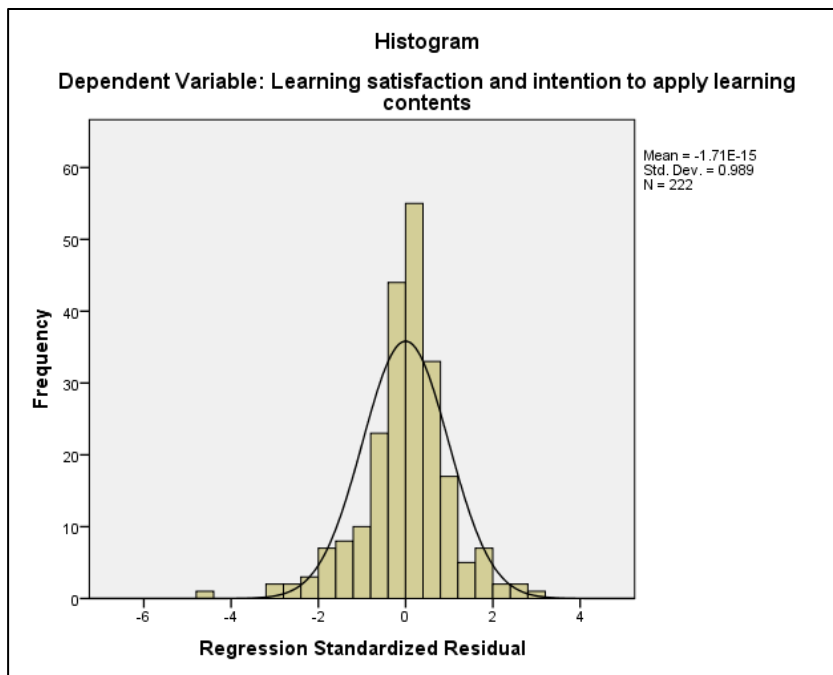


Figure 5-13: Histogram of regression standardized residual for the model of RQ1

### 5.3 RQ2: Results of t-test and Man-Whitney U-test

#### 5.3.1 Descriptive analysis

In answering research question two “Are there any differences in internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, effort regulation, and learning satisfaction and intention to apply learning contents between those who used interactive teacher training materials and those who do not?”, descriptive statistics was conducted first to get an overview of the data before t-test.

Based on Table 5-4, the following observations can be made:

- 1) In terms of learning satisfaction and intention to apply learning contents, there are 131 teachers using interactive material and 114 teachers without using interactive material being compared. The learning satisfaction and intention to apply learning contents is higher for teachers using interactive material ( $M = 6.01$ ,  $SD = 0.92$ ) than teachers without using interactive material ( $M = 5.76$ ,  $SD = 0.99$ ).
- 2) In terms of internal motivation, there are 127 teachers using interactive material and 109 teachers without using interactive material being compared. The internal motivation is higher for teachers using interactive material ( $M = 5.77$ ,  $SD = 0.84$ ) than teachers without using interactive material ( $M = 5.58$ ,  $SD = 0.98$ ).
- 3) In terms of motivation for better assessment, there are 129 teachers using interactive material and 116 teachers without using interactive material being compared. The motivation for better assessment is higher for teachers using interactive material ( $M = 5.27$ ,  $SD = 1.16$ ) than teachers without using interactive material ( $M = 4.76$ ,  $SD = 1.53$ ).
- 4) In terms of planning and organizing skills, there are 129 teachers using interactive material and 112 teachers without using interactive material being compared. The use of planning and organizing skills is higher for teachers using interactive material ( $M = 5.70$ ,  $SD = 0.97$ ) than teachers without using interactive material ( $M = 5.57$ ,  $SD = 1.13$ ).

- 5) In terms of critical and positive thinking skills, there are 128 teachers using interactive material and 115 teachers without using interactive material being compared. The use of critical and positive skills is higher for teachers using interactive material ( $M = 5.58$ ,  $SD = 0.93$ ) than teachers without using interactive material ( $M = 5.43$ ,  $SD = 1.05$ ).
- 6) In terms of effort regulation, there are 131 teachers using interactive material and 116 teachers without using interactive material being compared. The effort regulation is higher for teachers using interactive material ( $M = 5.22$ ,  $SD = 1.47$ ) than teachers without using interactive material ( $M = 5.11$ ,  $SD = 1.25$ ).

**Table 5-4: Descriptive statistics for RQ2**

	Use of interactive material	N	Mean	Std. Deviation	Std. Error Mean
Learning satisfaction and intention to apply learning contents	Interactive	131	6.008	.922	.081
	Non-Interactive	114	5.763	.986	.092
Internal motivation	Interactive	127	5.768	.843	.075
	Non-Interactive	109	5.577	.983	.094
Motivation for better assessment	Interactive	129	5.267	1.163	.102
	Non-Interactive	116	4.763	1.531	.142
Planning and organizing skills	Interactive	129	5.698	.968	.085
	Non-Interactive	112	5.571	1.126	.106
Critical and positive thinking skills	Interactive	128	5.578	.928	.082
	Non-Interactive	115	5.426	1.053	.098
Effort regulation	Interactive	131	5.221	1.469	.128
	Non-Interactive	116	5.112	1.248	.116

### 5.3.2 T-test result

Table 5-5 is a summary of hypotheses testing result for research question 2, with detailed t-test result shown in Table 5-6. The hypothesis testing result using t-test shown in Table 5-5 shows that that 2 statistically significantly mean differences exist, supporting 2 hypotheses:

- 1) A statistically significantly mean difference is found between teachers using interactive materials and teachers without using interactive materials in learning satisfaction and intention to apply learning contents. There was homogeneity of variances, as assessed by Levene's test for equality of variances ( $p = .260$ ).

Learning satisfaction and intention to apply learning contents is higher for teachers using interactive materials ( $M = 6.01$ ,  $SD = 0.92$ ) than teachers without using interactive materials ( $M = 5.76$ ,  $SD = 0.99$ ). A statistically significant mean difference 0.24 is shown by t-test,  $t(243) = 2.004$ ,  $p = .046$ . Confidence interval of the difference (95%) is from 0.004 to 0.485.

- 2) A statistically significantly mean difference is found between teachers using interactive materials and teachers without using interactive materials in motivation for better assessment. A Welch t-test was run to determine if there were differences in motivation for better assessment between teachers using interactive materials and teachers without using interactive materials, due to the assumption of homogeneity of variances being violated, as assessed by Levene's test for equality of variances ( $p = .001$ ). Motivation for better assessment is higher for teachers using interactive materials ( $M = 5.27$ ,  $SD = 1.16$ ) than teachers without using interactive material ( $M = 4.76$ ,  $SD = 1.53$ ). A statistically significant mean difference 0.51 is shown by t-test,  $t(213.552) = 2.879$ ,  $p = .004$ . Confidence interval of the difference (95%) is from 0.159 to 0.850.

Table 5-5 summarizes the hypothesis testing result for research question 2. It can be seen that two hypotheses are accepted: 1) Hypothesis 2.2: Teachers who utilize interactive teacher training materials perceive higher motivation for better assessment than those who do not, and 2) Hypothesis 2.6: Teachers who utilize interactive teacher training materials perceive higher learning satisfaction and intention to apply learning contents.

**Table 5-5: Hypothesis testing result using t-test for RQ2**

Alternative hypothesis ( $H_1$ )	t	Significance	Decision
Hypothesis 2.1: Teachers who utilize interactive teacher training materials perceive higher internal motivation than those who do not	1.612	0.108	Reject the alternative hypothesis
Hypothesis 2.2: Teachers who utilize interactive teacher training materials perceive higher motivation for better assessment than those who do not.	2.879	0.004	Retain the alternative hypothesis
Hypothesis 2.3: Teachers who utilize interactive teacher training materials perceive higher use of critical and positive thinking skills than those who do not.	0.936	0.350	Reject the alternative hypothesis
Hypothesis 2.4: Teachers who utilize interactive teacher training materials perceive higher use of planning and organizing skills than those who do not.	1.196	0.233	Reject the alternative hypothesis
Hypothesis 2.5: Teachers who utilize interactive teacher training materials perceive higher effort regulation than those who do not.	0.626	0.532	Reject the alternative hypothesis
Hypothesis 2.6: Teachers who utilize interactive teacher training materials perceive higher learning satisfaction and intention to apply learning contents.	2.004	0.046	Retain the alternative hypothesis

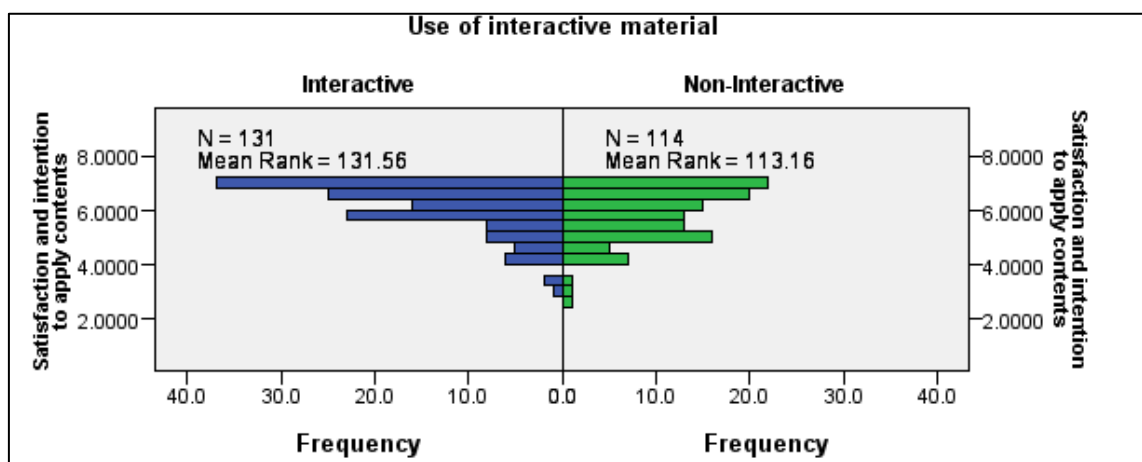
**Table 5-6: Independent samples t-test result for RQ2**

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Internal motivation	Equal variances assumed	1.717	.191	1.612	234	.108	.192	.119	-.043	.426
	Equal variances not assumed			1.593	214.264	.113	.192	.120	-.045	.429
Motivation for better assessment	Equal variances assumed	12.230	.001	2.921	243	.004	.505	.173	.164	.845
	Equal variances not assumed			2.879	213.552	.004	.505	.175	.159	.850
Critical and positive thinking skills	Equal variances assumed	2.484	.116	1.196	241	.233	.152	.127	-.098	.402
	Equal variances not assumed			1.188	228.718	.236	.152	.128	-.100	.404
Planning and organizing skills	Equal variances assumed	1.407	.237	.936	239	.350	.126	.135	-.139	.392
	Equal variances not assumed			.926	220.517	.355	.126	.136	-.142	.395
Effort regulation	Equal variances assumed	2.317	.129	.626	245	.532	.109	.175	-.235	.453
	Equal variances not assumed			.632	244.589	.528	.109	.173	-.231	.450
Learning satisfaction and intention to apply learning contents	Equal variances assumed	1.276	.260	2.004	243	.046	.244	.122	.004	.485
	Equal variances not assumed			1.995	233.010	.047	.244	.123	.003	.486

### 5.3.3 Man-Whitney U-test result

Man-Whitney U-test is used to test whether the significant differences exist in terms of self-regulation processes and learning satisfaction between teachers who utilized interactive materials and teachers who did not. This test offers an alternative approach in answering research question 2, as the data is skewed and the t-test result may be invalid. Based on Table 5-7, the following observations can be made.

- 1) A Mann-Whitney U test was run to determine if there were differences in learning satisfaction and intention to apply learning contents between teachers who use interactive materials and teachers who do not use interactive materials. Distributions of the learning satisfaction and intention to apply learning contents scores for two groups of teachers were not similar, as assessed by visual inspection of Figure 5-14. As demonstrated by hypothesis testing shown in Table 5-7, learning satisfaction and intention to apply learning contents scores for teachers who use interactive materials (mean rank = 131.56) were statistically significantly higher than for teachers who do not use interactive materials (mean rank = 113.16),  $U = 8589$ ,  $p = .042$ .

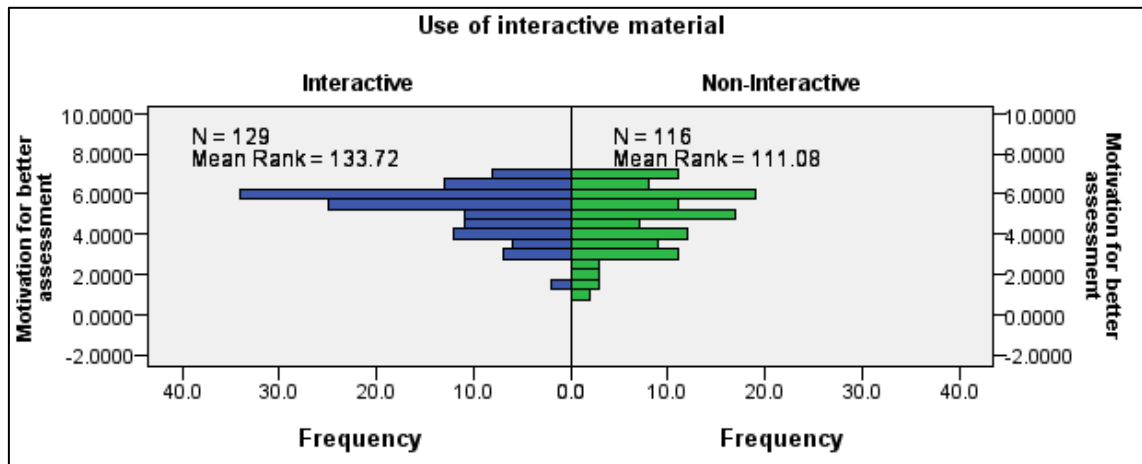


**Figure 5-14: Independent samples U-test for learning satisfaction and intention to apply learning contents**

Source: created by author.

- 2) A Mann-Whitney U test was run to determine if there were differences in motivation for better assessment between teachers who use interactive materials and teachers who do not use interactive materials. Distributions of the

motivation for better assessment scores for two groups of teachers were not similar, as assessed by visual inspection of Figure 5-15. As demonstrated by hypothesis testing shown in Table 5-7, motivation for better assessment scores for teachers who use interactive materials (mean rank = 133.72) were statistically significantly higher than for teachers who do not use interactive materials (mean rank = 111.08),  $U = 8865$ ,  $p = .012$ .



**Figure 5-15: Independent samples U-test for motivation for better assessment**  
Source: created by author.

Table 5-7 shows the summary of hypotheses testing using Mann-Whitney U-test for research question 2. It can be seen that the null hypotheses are denied stating that no significant difference in the distributions of motivation for better assessment and learning satisfaction and intention to apply learning contents. These findings agree with the previous hypotheses testing results using t-test, as shown in Table 5-5.

**Table 5-7: Hypothesis testing result using Mann-Whitney U-test for RQ2**

Null hypothesis ( $H_0$ )	Mann-Whitney U	Significance	Decision
The distribution of internal motivation is the same across the categories of the use of interactive materials	7636	0.171	Retain the null hypothesis
The distribution of motivation for better assessment is the same across the categories of the use of interactive materials	8865	0.012	Reject the null hypothesis
The distribution of planning and organizing skills is the same across the categories of the use of interactive materials	7563	0.529	Retain the null hypothesis
The distribution of critical and positive thinking skills is the same across the categories of the use of interactive materials	7872.5	0.346	Retain the null hypothesis
The distribution of effort regulation is the same across the categories of the use of interactive materials	8267.5	0.228	Retain the null hypothesis
The distribution of learning satisfaction and intention to apply learning contents is the same across the categories of the use of interactive materials	8589	0.042	Reject the null hypothesis

#### 5.4 RQ3: Result of moderated multiple linear regression

In order to answer research question 3 “Does the use of interactive materials affect the relationship between learning satisfaction and intention to apply learning contents with internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, as well as effort regulation?”, five models of moderated multiple linear regression were tested (see Table 5-8). Five models are tested to understand the effect of interactive materials on the influence of five self-regulation process on learning satisfaction and intention to apply learning contents. The following sub-sections are laying out the model results for five moderated multiple linear regression.

**Table 5-8: Models of moderated multiple linear regression for RQ3**

Model	Focal independent variable	Moderator variable	Other independent variables	Dependent variable	Hypothesis
Model 3.1	Internal motivation	Use of interactive material	Motivation for better assessment Planning and organizing skills Critical and positive thinking skills Effort regulation	Learning satisfaction and intention to apply learning contents	Hypothesis 3.1: Internal motivation has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.
Model 3.2	Motivation for better assessment	Use of interactive material	Internal motivation Planning and organizing skills Critical and positive thinking skills Effort regulation	Learning satisfaction and intention to apply learning contents	Hypothesis 3.2: Motivation for better assessment has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.
Model 3.3	Planning and organizing skills	Use of interactive material	Internal motivation Motivation for better assessment Critical and positive thinking skills Effort regulation	Learning satisfaction and intention to apply learning contents	Hypothesis 3.3: Planning and organizing skills have stronger influences on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.
Model 3.4	Critical and positive thinking skills	Use of interactive material	Internal motivation Motivation for better assessment Planning and organizing skills Effort regulation	Learning satisfaction and intention to apply learning contents	Hypothesis 3.4: Critical and positive thinking skills have stronger influences on learning satisfaction and intention to apply learning contents when teachers who utilize interactive materials.
Model 3.5	Effort regulation	Use of interactive material	Internal motivation Motivation for better assessment Planning and organizing skills Critical and positive thinking skills	Learning satisfaction and intention to apply learning contents	Hypothesis 3.5: Effort regulation has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.

Note: Focal independent variable is the independent variable that its effect on dependent variable is assumed to be moderated by the moderator variable.

### 5.4.1 RQ3: Result of model 3.1

Model 3.1 is to test the influence of interactive materials to internal motivation's effect on learning satisfaction and intention to apply learning contents. The regression equation of model 3.1 can be written as:

$$Y = b_0 + b_1\text{Intr} + b_2\text{Motiv} + b_3\text{Planorg} + b_4\text{Crit} + b_5\text{Eff} + b_6\text{Interact} + b_7\text{Intr*Interact} \quad (5.3)$$

In equation 5.3, Y is the learning satisfaction and intention to apply learning contents. Intr refers to internal motivation, Motiv refers to motivation for better assessment, Planorg refers to planning and organizing skills, Crit refers to critical and positive thinking skills, Eff refers to effort regulation, Interact refers to use of interactive material, and Intr\*Interact refers to the moderation term which is the product of internal motivation and use of interactive material.

Moderated multiple linear regression gives the regression coefficients shown in Table 5-9. The significance test shows that three independent variables, 1) internal motivation, 2) planning and organizing skills, and 3) critical and positive thinking skills are statistically significantly affecting the dependent variable, learning satisfaction and intention to apply learning contents, significant at  $p < 0.0005$ . The test also confirms the significant moderating effect by the use of interactive material, as the moderator variable is statistically significant ( $p < 0.05$ ).

**Table 5-9: Coefficients<sup>a</sup> of Model 3.1**

Mode	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
3.1(Constant)	<b>1.616</b>	.354		4.561	<b>.000</b>
Internal motivation	<b>.344</b>	.071	.323	4.846	<b>.000</b>
Motivation for better assessment	-.053	.035	-.076	-1.512	.132
Planning and organizing skills	<b>.248</b>	.055	.268	4.532	<b>.000</b>
Critical and positive thinking skills	<b>.216</b>	.060	.222	3.603	<b>.000</b>
Effort regulation	-.014	.033	-.021	-.437	.663
Use of interactive material	-.764	.407	-.401	-1.877	.062
Internal motivation_moderator	<b>.160</b>	.072	.491	2.241	<b>.026</b>

a. Dependent Variable: Satisfaction and intention to apply contents

Based on the regression model and the regression result, the regression coefficients in equation 5.3 can be substituted with the estimated coefficients, as shown in equation 5.4.

$$Y = 1.616 + 0.344\text{Intr} + 0.248\text{Planorg} + 0.216\text{Crit} + 0.16\text{Intr*Interact} \quad (5.4)$$

Equation 5.4 shows that the use of interactive material moderates the effect of internal motivation on learning satisfaction and intention to apply learning contents, supporting hypothesis 3.1. Controlling the effect of planning and organizing skills, and critical and positive thinking skills, for teachers without using interactive materials perceiving higher internal motivation by 1 scale score, their perceptions on learning satisfaction and intention to apply learning contents increases by 0.344 scale score. For teachers using interactive materials, perceiving higher internal motivation by 1 scale score will result in 0.504 scale score increase in learning satisfaction and intention to apply learning contents. This means that comparing teachers using interactive materials to teachers without them, perceiving higher internal motivation by 1 scale score will have an additional positive effect on learning satisfaction and intention to apply learning contents by 0.16 scale score.

Table 5-10 shows the adjusted R<sup>2</sup> of 0.533 which means that 53.3% of the variance in teacher's learning satisfaction is explained by the model 3.1 shown in equation 5.4.

**Table 5-10: Model 3.1 Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3.1	.739 <sup>a</sup>	.546	.533	.651

a. Predictors: (Constant), Effort regulation, Use of interactive material, Motivation for better assessment, Planning and organizing skills, Internal motivation, Critical and positive thinking skills, Internal motivation\_moderator

Table 5-11 shows the test result for the significance of the model. The F-test yielded the result that  $F(7, 248) = 41.371$ ,  $p < .0005$ . This means that the null hypothesis that all regression coefficients equal to zero is rejected. In this study context, it means that regression model is statistically significant.

**Table 5-11: ANOVA<sup>a</sup> for Model 3.1**

Model		Sum of Squares	df	Mean Square	F	Sig.
3.1	Regression	122.551	7	17.507	41.371	.000 <sup>b</sup>
	Residual	101.986	241	.423		
	Total	224.537	248			

a. Dependent Variable: Satisfaction and intention to apply contents

b. Predictors: (Constant), Effort regulation, Use of interactive material, Motivation for better assessment, Planning and organizing skills, Internal motivation, Critical and positive thinking skills, Internal motivation\_moderator

#### 5.4.2 RQ3: Result of model 3.2

Model 3.2 is to test the influence of interactive materials to motivation for better assessment's effect on learning satisfaction and intention to apply learning contents.

The regression equation of model 3.2 can be written as:

$$Y = b_0 + b_1\text{Intr} + b_2\text{Motiv} + b_3\text{Planorg} + b_4\text{Crit} + b_5\text{Eff} + b_6\text{Interact} + b_7\text{Motiv*Interact} \quad (5.5)$$

In equation 5.5, Y is the learning satisfaction and intention to apply learning contents. Intr refers to internal motivation, Motiv refers to motivation for better assessment, Planorg refers to planning and organizing skills, Crit refers to critical and positive thinking skills, Eff refers to effort regulation, Interact refers to use of interactive material, Motiv\*Interact refers to the moderation term which is the product of motivation for better assessment and use of interactive material.

Moderated multiple linear regression gives the regression coefficients shown in Table 5-12. The significance test shows that four independent variables, 1) internal motivation, 2) motivation for better assessment, 3) planning and organizing skills, and 4) critical and positive thinking skills are statistically significantly affecting the dependent variable, learning satisfaction and intention to apply learning contents, significant at  $p < 0.05$  for motivation for better assessment and  $p < 0.0005$  for the rest of the variables. The test also confirms the significant moderating effect by the use of interactive material, as the moderator variable is statistically significant ( $p < 0.05$ ).

**Table 5-12: Coefficients<sup>a</sup> for Model 3.2**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
3.2 (Constant)	1.458	.327		4.462	.000
Internal motivation	.393	.066	.368	5.964	.000
Motivation for better assessment	-.090	.041	-.129	-2.198	.029
Planning and organizing skills	.253	.055	.274	4.613	.000
Critical and positive thinking skills	.228	.060	.235	3.806	.000
Effort regulation	-.020	.033	-.029	-.608	.544
Use of interactive material	-.475	.311	-.249	-1.526	.128
Motivation for better assessment_moderator	.120	.060	.347	2.014	.045

a. Dependent Variable: Satisfaction and intention to apply contents

Based on the regression model and the regression result, the regression coefficients in equation 5.5 can be substituted with the estimated coefficients, as shown in equation 5.6.

$$Y = 1.458 + 0.393\text{Intr} - 0.09\text{Motiv} + 0.253\text{Planorg} + 0.228\text{Crit} + 0.12\text{Motiv}*\text{Interact} \quad (5.6)$$

Equation 5.6 shows that the use of interactive material moderates the effect of motivation for better assessment on learning satisfaction and intention to apply learning contents, supporting hypothesis 3.2. Controlling the effects of internal motivation, critical and positive thinking skills, and planning and organizing skills, for teachers without using interactive materials perceiving higher internal motivation by 1 scale score, their perceptions on learning satisfaction and intention to apply learning contents decreases by 0.09 scale score. For teachers using interactive materials, perceiving higher internal motivation by 1 scale score will result in 0.03 scale score increase in learning satisfaction and intention to apply learning contents. This means that comparing teachers using interactive materials to teachers without them, perceiving higher internal motivation by 1 scale score will change motivation for better assessment's direction of effect on learning satisfaction and intention to apply learning contents.

It should be noted that the regression coefficients of motivation for better assessment and its moderation term are significant in this model 3.2. This result is

in contrast to the result from other models, where the coefficient of motivation for better assessment is found insignificant. This phenomenon is contributed by the characteristic of the model 3.2, where the addition of the moderation term on motivation for better assessment changes the evaluation of the coefficients. Through examining the coefficients Table 5-12 of this model, it can be found that the magnitudes of the coefficients of motivation for better assessment (-0.09) and its moderation term (0.12) are small. Furthermore, the addition of these two coefficients is close to zero (0.03). In terms of the significance level, these coefficients are both significant at  $p < 0.05$  level, which is marginally significant. Considering these quantitative measures, the regression coefficients of motivation for better assessment and its moderation term should be interpreted with caution. The result here suggests that the use of interactive materials do have an influence on the effect of motivation for better assessment on learning satisfaction. However, the magnitude of the coefficients and its significance levels suggest that the effect of motivation for better assessment on learning satisfaction is rather small, but detectable when considering the influence of the use of interactive materials.

Table 5-13 shows the adjusted  $R^2$  of 0.531 which means that 53.1% of the variance in teacher's learning satisfaction is explained by the model 3.2 shown in equation 5.6.

**Table 5-13: Model 3.2 Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3.2	.738 <sup>a</sup>	.544	.531	.652

a. Predictors: (Constant), Effort regulation, Use of interactive material, Motivation for better assessment, Planning and organizing skills, Internal motivation, Critical and positive thinking skills, Motivation for better assessment\_moderator

Table 5-14 shows the test result for the significance of the model. The F-test yielded the result that  $F(7, 248) = 41.074$ ,  $p < .0005$ . This means that the null hypothesis that all regression coefficients equal to zero is rejected. In this study context, it means that regression model is statistically significant.

**Table 5-14: ANOVA<sup>a</sup> for Model 3.2**

Model		Sum of Squares	df	Mean Square	F	Sig.
3.2	Regression	122.150	7	17.450	41.074	.000 <sup>b</sup>
	Residual	102.388	241	.425		
	Total	224.537	248			

a. Dependent Variable: Satisfaction and intention to apply contents

b. Predictors: (Constant), Effort regulation, Use of interactive material, Motivation for better assessment, Planning and organizing skills, Internal motivation, Critical and positive thinking skills, Motivation for better assessment\_moderator

#### 5.4.3 RQ3: Result of model 3.3

Model 3.3 is to test the influence of interactive materials to planning and organizing skill's effect on learning satisfaction and intention to apply learning contents. The regression equation of model 3.4 can be written as:

$$Y = b_0 + b_1\text{Intr} + b_2\text{Motiv} + b_3\text{Planorg} + b_4\text{Crit} + b_5\text{Eff} + b_6\text{Interact} + b_7\text{Planorg*Interact} \quad (5.7)$$

In equation 5.7, Y is the learning satisfaction and intention to apply learning contents. Intr refers to internal motivation, Motiv refers to motivation for better assessment, Planorg refers to planning and organizing skills, Crit refers to critical and positive thinking skills, Eff refers to effort regulation, Interact refers to use of interactive material, and Planorg\*Interact refers to the moderation term which is the product of planning and organizing skills and use of interactive material.

Moderated multiple linear regression gives the regression coefficients shown in Table 5-15. The significance test shows that three independent variables, 1) internal motivation, 2) planning and organizing skills, and 3) critical and positive thinking skills are statistically significantly affecting the dependent variable, learning satisfaction and intention to apply learning contents, significant at  $p < 0.0005$ . The test also shows that the moderating effect by the use of interactive material is not statistically significant, as the moderator variable is not statistically significant ( $p > 0.05$ ).

**Table 5-15: Coefficients<sup>a</sup> for Model 3.3**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
3.3 (Constant)	1.269	.359		3.536	.000
Internal motivation	.408	.066	.382	6.186	.000
Motivation for better assessment	-.048	.035	-.068	-1.345	.180
Planning and organizing skills	.238	.062	.258	3.837	.000
Critical and positive thinking skills	.220	.061	.226	3.618	.000
Effort regulation	-.014	.033	-.021	-.432	.666
Use of interactive material	-.065	.409	-.034	-.159	.874
Planning and organizing skills_moderator	.035	.072	.106	.483	.629

a. Dependent Variable: Satisfaction and intention to apply contents

Based on the regression model and the regression result, the regression coefficients in equation 5.7 can be substituted with the estimated coefficients, as shown in equation 5.8.

$$Y = 1.269 + 0.408\text{Intr} + 0.238\text{Planorg} + 0.22\text{Crit} \quad (5.8)$$

Equation 5.8 shows that the use of interactive material does not moderate the effect of planning and organizing skills on learning satisfaction and intention to apply learning contents, denying hypothesis 3.3.

Table 5-16 shows the adjusted R<sup>2</sup> of 0.523 which means that 52.3% of the variance in teacher's learning satisfaction is explained by the model 3.3 shown in equation 5.8.

**Table 5-16: Model 3.3 Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3.3	.733 <sup>a</sup>	.537	.523	.657

a. Predictors: (Constant), Effort regulation, Use of interactive material, Motivation for better assessment, Planning and organizing skills, Internal motivation, Critical and positive thinking skills, Planning and organizing skills\_moderator

Table 5-17 shows the test result for the significance of the model. The F-test yielded the result that  $F(7, 248) = 39.896$ ,  $p < .0005$ . This means that the null hypothesis

that all regression coefficients equal to zero is rejected. In this study context, it means that regression model is statistically significant.

**Table 5-17: ANOVA<sup>a</sup> for Model 3.3**

Model		Sum of Squares	df	Mean Square	F	Sig.
3.3	Regression	120.527	7	17.218	39.896	.000 <sup>b</sup>
	Residual	104.010	241	.432		
	Total	224.537	248			

a. Dependent Variable: Satisfaction and intention to apply contents

b. Predictors: (Constant), Effort regulation, Use of interactive material, Motivation for better assessment, Planning and organizing skills, Internal motivation, Critical and positive thinking skills, Planning and organizing skills\_moderator

#### 5.4.4 RQ3: Result of model 3.4

Model 3.4 is to test the influence of interactive materials to critical and positive thinking skill's effect on learning satisfaction and intention to apply learning contents. The regression equation of model 3.4 can be written as:

$$Y = b_0 + b_1\text{Intr} + b_2\text{Motiv} + b_3\text{Planorg} + b_4\text{Crit} + b_5\text{Eff} + b_6\text{Interact} + b_7\text{Crit*Interact} \quad (5.9)$$

In equation 5.9, Y is the learning satisfaction and intention to apply learning contents. Intr refers to internal motivation, Motiv refers to motivation for better assessment, Planorg refers to planning and organizing skills, Crit refers to critical and positive thinking skills, Eff refers to effort regulation, Interact refers to use of interactive material, and Crit\*Interact refers to the moderation term which is the product of critical and positive thinking skills and use of interactive material.

Moderated multiple linear regression gives the regression coefficients shown in Table 5-18. The significance test shows that three independent variables, 1) internal motivation, 2) planning and organizing skills, and 3) critical and positive thinking skills are statistically significantly affecting the dependent variable, learning satisfaction and intention to apply learning contents, significant at  $p < 0.005$  for critical and positive thinking skills and  $p < 0.0005$  for the rest of the variables. The test also shows that the moderating effect by the use of interactive material is not statistically significant, as the moderator variable is not statistically significant ( $p > 0.05$ ).

**Table 5-18: Coefficients<sup>a</sup> for Model 3.4**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
3.3 (Constant)	1.358	.350		3.875	.000
Internal motivation	.406	.066	.380	6.163	.000
Motivation for better assessment	-.049	.035	-.070	-1.377	.170
Planning and organizing skills	.248	.055	.268	4.482	.000
Critical and positive thinking skills	.196	.066	.201	2.958	.003
Effort regulation	-.014	.033	-.020	-.412	.681
Use of interactive material	-.224	.365	-.118	-.614	.540
Critical and positive thinking skills_moderator	.066	.066	.195	.992	.322

a. Dependent Variable: Satisfaction and intention to apply contents

Based on the regression model and the regression result, the regression coefficients in equation 5.9 can be substituted with the estimated coefficients, as shown in equation 5.10.

$$Y = 1.358 + 0.406Intr + 0.248Planorg + 0.196Crit \quad (5.10)$$

Equation 5.10 shows that the use of interactive material does not moderate the effect of critical and positive thinking skills on learning satisfaction and intention to apply learning contents, denying hypothesis 3.4.

Table 5-19 shows the adjusted R<sup>2</sup> of 0.525 which means that 52.5% of the variance in teacher's learning satisfaction is explained by the model 3.4 shown in equation 5.10.

**Table 5-19: Model 3.4 Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3.4	.734 <sup>a</sup>	.538	.525	.656

a. Predictors: (Constant), Effort regulation, Use of interactive material, Motivation for better assessment, Planning and organizing skills, Internal motivation, Critical and positive thinking skills, Critical and positive thinking skills\_moderator

Table 5-20 shows the test result for the significance of the model. The F-test yielded the result that  $F(7, 248) = 40.127$ ,  $p < .0005$ . This means that the null hypothesis

that all regression coefficients equal to zero is rejected. In this study context, it means that regression model is statistically significant.

**Table 5-20: ANOVA<sup>a</sup> for Model 3.4**

Model		Sum of Squares	df	Mean Square	F	Sig.
3.4	Regression	120.850	7	17.264	40.127	.000 <sup>b</sup>
	Residual	103.687	241	.430		
	Total	224.537	248			

a. Dependent Variable: Satisfaction and intention to apply contents

b. Predictors: (Constant), Effort regulation, Use of interactive material, Motivation for better assessment, Planning and organizing skills, Internal motivation, Critical and positive thinking skills, Critical and positive thinking skills\_moderator

#### 5.4.5 RQ3: Result of model 3.5

Model 3.5 is to test the influence of interactive materials to effort regulation's effect on learning satisfaction and intention to apply learning contents. The regression equation of model 3.5 can be written as:

$$Y = b_0 + b_1\text{Intr} + b_2\text{Motiv} + b_3\text{Planorg} + b_4\text{Crit} + b_5\text{Eff} + b_6\text{Interact} + b_7\text{Eff*Interact} \quad (5.11)$$

In equation 5.11, Y is the learning satisfaction and intention to apply learning contents. Intr refers to internal motivation, Motiv refers to motivation for better assessment, Planorg refers to planning and organizing skills, Crit refers to critical and positive thinking skills, Eff refers to effort regulation, Interact refers to use of interactive material, and Eff\*Interact refers to the moderation term which is the product of effort regulation and use of interactive material.

Moderated multiple linear regression gives the regression coefficients shown in Table 5-21. The significance test shows that three independent variables, 1) internal motivation, 2) planning and organizing skills, and 3) critical and positive thinking skills are statistically significantly affecting the dependent variable, learning satisfaction and intention to apply learning contents, significant at  $p < 0.0005$ . The test also shows that the moderating effect by the use of interactive material is not statistically significant, as the focal independent variable is not statistically significant ( $p > 0.05$ ) although moderator variable is statistically significant ( $p < 0.05$ ).

**Table 5-21: Coefficients<sup>a</sup> for Model 3.5**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
3.5 (Constant)	1.551	.338		4.583	.000
Internal motivation	.415	.065	.388	6.347	.000
Motivation for better assessment	-.056	.035	-.080	-1.591	.113
Planning and organizing skills	.243	.055	.263	4.427	.000
Critical and positive thinking skills	.238	.060	.244	3.953	.000
Effort regulation	-.094	.048	-.137	-1.931	.055
Use of interactive material	-.563	.318	-.295	-1.770	.078
Effort regulation_moderator	.135	.060	.399	2.254	.025

a. Dependent Variable: Satisfaction and intention to apply contents

Based on the regression model and the regression result, the regression coefficients in equation 5.11 can be substituted with the estimated coefficients, as shown in equation 5.12.

$$Y = 1.551 + 0.415\text{Intr} + 0.238\text{Planorg} + 0.243\text{Crit} + 0.135\text{Eff*Interact} \quad (5.12)$$

Equation 5.12 shows that the use of interactive material does not moderate the effect of planning and organizing skills on learning satisfaction and intention to apply learning contents, denying hypothesis 3.5.

Table 5-22 shows the adjusted R<sup>2</sup> of 0.533 which means that 53.3% of the variance in teacher's learning satisfaction is explained by the model 3.5 shown in equation 5.12.

**Table 5-22: Model 3.5 Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3.5	.739 <sup>a</sup>	.546	.533	.650

a. Predictors: (Constant), Critical and positive thinking skills, Use of interactive material, Motivation for better assessment, Effort regulation, Planning and organizing skills, Internal motivation, Effort regulation\_moderator

Table 5-23 shows the test result for the significance of the model. The F-test yielded the result that  $F(7, 248) = 41.389$ ,  $p < .0005$ . This means that the null hypothesis that all regression coefficients equal to zero is rejected. In this study context, it means that regression model is statistically significant.

**Table 5-23: ANOVA<sup>a</sup> for Model 3.5**

Model		Sum of Squares	df	Mean Square	F	Sig.
3.5	Regression	122.575	7	17.511	41.389	.000 <sup>b</sup>
	Residual	101.962	241	.423		
	Total	224.537	248			

a. Dependent Variable: Satisfaction and intention to apply contents

b. Predictors: (Constant), Critical and positive thinking skills, Use of interactive material, Motivation for better assessment, Effort regulation, Planning and organizing skills, Internal motivation, Effort regulation\_moderator

#### 5.4.6 Hypotheses testing results for RQ3

The hypotheses 3.1 to 3.5 are tested through the analysis of five moderation models 3.1 to 3.5. In order to accept each hypothesis, both focal and moderator variables should be statistically significant. Based on this principle, Table 5-24 summarizes the hypotheses testing results for research question 3. It can be seen that two hypotheses are accepted: 1) Hypothesis 3.1: Internal motivation has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials, and 2) Hypothesis 3.2: Motivation for better assessment has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.

**Table 5-24: Hypotheses testing results for RQ3**

Hypothesis	Significance levels of focal and moderator variables	Decision
Hypothesis 3.1: Internal motivation has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.	Internal motivation: $p < 0.0005$ Internal motivation_moderator: $p < 0.05$	Accept the hypothesis
Hypothesis 3.2: Motivation for better assessment has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.	Motivation for better assessment: $p < 0.05$ Motivation for better assessment_moderator: $p < 0.05$	Accept the hypothesis
Hypothesis 3.3: Planning and organizing skills have stronger influences on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.	Planning and organizing skills: $p > 0.05$ Planning and organizing skills_moderator: $p > 0.05$	Reject the hypothesis
Hypothesis 3.4: Critical and positive thinking skills have stronger influences on learning satisfaction and intention to apply learning contents when teachers who utilize interactive materials.	Critical and positive thinking skills: $p > 0.05$ Critical and positive thinking skills_moderator: $p > 0.05$	Reject the hypothesis
Hypothesis 3.5: Effort regulation has stronger influence on learning satisfaction and intention to apply learning contents when teachers utilize interactive materials.	Effort regulation: $p > 0.05$ Effort regulation_moderator: $p > 0.05$	Reject the hypothesis

## Chapter 6: Discussion

Three sections of this chapter provide discussions on the data analysis results in relation to the literature for each research question. Information from field interviews and discussions with local primary school teachers is utilized to evaluate and support the findings.

### 6.1 Research question 1

The first research question asks as follows:

What are the factors among internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, and effort regulation that affect learning satisfaction and intention to apply learning contents?

Based on the data analysis result, three processes out of five self-regulation processes, namely, internal motivation, planning and organizing skills, as well as critical and positive thinking skills are found to positively affect teachers' learning satisfaction and intention to apply learning contents. This section explains three major contributions to the literature on self-regulated learning. The local interpretation for each finding is based on the analysis of focus group discussions and interviews, for which the original data is included in Appendix 6, under the section "in relation to research question 1".

#### 6.1.1 Internal motivation affects learning satisfaction and intention to apply learning contents

Regarding internal motivation, the study contributes to the current discussion on self-regulated learning. This finding is consistent with the study by Wang, Shannon and Margaret (2013). The study found that the increased level of motivation lead to higher levels of course satisfaction and better performance in a distance learning environment. Further, the study of Wolters and Pintrich (1998) reported that internally motivated learners manage to increase the value of the learning task through connecting knowledge and their career experience, which results in higher learning satisfaction. In Mongolian context, group discussion at local school level

confirms this finding. Teachers who participated in the training are well informed and understand the value and need of upgrading their skills through training, resulting in high internal motivation. Internally motivated teachers conduct learning in the training with clear purpose, which leads to higher learning satisfaction and intention to apply learning contents. From the opposite perspective, teachers commented that the learning will not be effective if the value of learning in training is clear, hence negatively affecting learning satisfaction.

#### 6.1.2 Planning and organizing skill affects learning satisfaction and intention to apply learning contents

The planning and organizing skill significantly affects learning satisfaction and intention to apply learning contents. This result agrees with the finding from Kizilcec, Perez-Sanagustin, and Maldonado (2017), The study by Kizilcec et al. was conducted in the Massive Open Online Course (MOOC) environment, where learners are anticipated to actively and autonomously engage in the learning activity. The study found that the learners who are more engaged in the strategic planning, such as organizing study time to accomplish a goal to the best of one's ability, is more likely to attain positive learning satisfaction. Furthermore, Boekaerts et al. (2000) argued that planning activities such as learning task analysis can help activating previous knowledge which makes comprehending the learning materials easier, hence enhancing learning satisfaction. Mongolian primary school teachers reported a similar condition. With the rare teacher training opportunity, teachers were engaged in plan and organization for the teacher training by gathering relevant information in advance. In addition, teachers were formulating their training activity through note taking and organizing information for future reference when needed. Through careful coordination of the training materials, teachers could fully utilize their training opportunity, resulting higher learning satisfaction and intention to apply learning contents. A sound arrangement of the learning time can also avoid cognitive overloading (too much learning in a short period), which results in better learning satisfaction.

### 6.1.3 Critical and positive thinking skill affects learning satisfaction and intention to apply learning contents

The critical and positive thinking skill significantly affects learning satisfaction and intention to apply learning contents. This finding is consistent with the studies in the field. For example, Smith (2016) reported a case where teachers conducted lesson study for their professional development in the US. Teachers applied critical thinking skills in researching their question of interest and developed a lesson using their own knowledge, in connection to the educational standards. As a result, teachers had higher internal satisfaction and showed higher chances of applying the new pedagogies in their classroom activities. Moreover, Schraw et al. (2006) identified critical thinking to be one of the important factors that positively influences learning outcome in a science education program on the college level in the United States. In his study, learners apply critical thinking skill to draw the conclusion of the question through identifying sources of information and reflecting on whether the information is consistent with previous knowledge. Through the use of critical thinking skills, learners are able to acquire more knowledge efficiently, resulting in higher levels of learning satisfaction. In Mongolian context, critical and positive thinking skills are important to promote the understanding on the use of new pedagogies in the classroom teaching, hence leading to improved learning satisfaction and intention to apply learning contents. Teachers recognized that critical and positive thinking skills are the key in acquiring new knowledge. This is because that the teachers who consider critically and positively are able to seek for alternative explanations when they cannot figure out the issue encountered. It was also mentioned that critical and positive mindset is helpful in overcoming learning difficulties, hence affecting learning satisfaction. In Mongolian context where learning resources for teachers are limited, it was found that having positive mindset enables teachers to build relationships with other teachers even from different schools in solving the problem collaboratively. Furthermore, teachers feel that critical thinking skills allow teachers to keep their learning activities with related research topics introduced in training.

In summary, in answering research question 1, the study found that internal motivation, planning and organizing skill, and critical and positive thinking skill are important self-regulation processes affecting learning satisfaction and intention to apply learning contents for primary school teachers in Mongolia. The interview and discussion results help further explain the relevance of these three self-regulation processes in the Mongolian context, where training opportunities are rare and training resources are scarce.

## 6.2 Research question 2

The second research question asks as follows:

Are there any differences in internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, effort regulation, and learning satisfaction and intention to apply learning contents between those who used interactive teacher training materials and those who do not?

In answering this research question, six hypotheses were tested. T-test was conducted to test these hypotheses. There are two major findings in answering the research question 2. First, the significant difference is found in motivation for better assessment between teachers who utilized interactive materials and teachers who did not utilize them. Second, the significant difference is also found in learning satisfaction and intention to apply learning contents between two groups of teachers mentioned earlier. This section explains these two differences by referring to the literature. Further, reasons for the denied hypotheses are interpreted in section 6.4. The local interpretation for each finding is based on the analysis of focus group discussions and interviews, for which the original data is included in Appendix 6, under the section “in relation to research question 2”.

### 6.2.1 Hypotheses testing for research question 2

There are six hypotheses corresponding with research question 2 as shown below.

Hypothesis 2.1: Teachers who utilize interactive teacher training materials perceive higher internal motivation than those who do not (Carneiro et al., 2011; Domagk et al., 2010; Kennedy, 2004).

Hypothesis 2.2: Teachers who utilize interactive teacher training materials perceive higher motivation for better assessment than those who do not (Kang & Tan, 2014; Law et al., 2010; Selvi, 2010).

Hypothesis 2.3: Teachers who utilize interactive teacher training materials perceive higher use of critical and positive thinking skills than those who do not (Gharib et al., 2016; Haghparast et al., 2014).

Hypothesis 2.4: Teachers who utilize interactive teacher training materials perceive higher use of planning and organizing skills than those who do not (Delen et al., 2014; Johnson et al., 2009; Kennedy, 2004).

Hypothesis 2.5: Teachers who utilize interactive teacher training materials perceive higher effort regulation than those who do not (Nada Dabbagh et al., 2004; Rakes & Dunn, 2010).

Hypothesis 2.6: Teachers who utilize interactive teacher training materials perceive higher learning satisfaction and intention to apply learning contents (Violante & Vezzetti, 2015).

The data analysis supports two hypotheses. First, hypothesis 2.2 is supported, which states that teachers who utilize interactive teacher training materials perceive higher motivation for better assessment than those who do not. Second, hypothesis 2.6 is supported, which states that teachers who utilize interactive teacher training materials perceive higher learning satisfaction and intention to apply learning contents. The results are interpreted in the following section.

#### 6.2.2 Teachers using interactive materials perceive higher motivation for better assessment

Teachers who utilized interactive materials perceived higher motivation for better assessment. This result agrees with the literature which found that an e-learning environment with self-assessment and competence feedback features can enhance learning motivation which subsequently influence the interest in the learning task (Law et al., 2010). Furthermore, Selvi (2010) discussed several factors promoting learner's extrinsic motivation in an online course, such as giving quizzes and

exams, putting detailed contents, and offering freedom to learn at learners' own pace. Interviews with primary school teachers in Mongolia support the literature. Teachers with interactive materials perceived higher motivation for achieving better assessment since they want to precisely understand of the learning contents. Interactive materials are capable of providing teachers with immediate feedback to identify their areas of weakness in understanding the training content, and hence assisting teachers to respond to the quizzes correctly. Traditionally, motivation for better assessment is not perceived as a motivational process that is as noble as internal motivation (Pintrich, 2000; Enabou & Tirole, 2003; Johnson-Graham, 2012), since it is originated from extrinsic incentives such as outperform other learners instead of self-improvement for the learner himself. However, in Mongolian context, teachers using interactive materials are motivated to get the correct answer through gathering extra information from different sources such as the Internet and their peers. With limited learning resources, teachers make effectiveness use of interactive materials through the attempt to retrieve additional information. Through the research process, they become more curious about the topic they are working on.

### 6.2.3 Teachers using interactive materials perceive higher learning satisfaction and intention to apply learning contents

In terms of learning outcome, the learning satisfaction and intention to apply learning contents is found to be higher for teachers who utilize interactive materials. This result agrees with the current discussion on interactive learning materials and learning satisfaction. Bernard et al. (2009) confirmed the importance of integrating high-quality interactive learning contents in promoting learning satisfaction. The study emphasized that the dynamic representation of knowledge, such as using both text and graphs, may help making complex ideas more understandable, which results in better learning satisfaction. Similarly, Violante et al. (2015) found that characteristics such as easy navigation and exploration, realism, and graphical depiction are associated with learner's learning satisfaction. These characteristics help learners to get familiar with the learning contents even when their previous knowledge is insufficient, thus promoting learning satisfaction. In the case of

Mongolian primary school teachers, there are several aspects of interactive learning materials that contribute to learning satisfaction. First, teachers report that adding interactivity in their learning can help them better focus on important learning content as the programme highlights the core theories and important concepts. Second, interactive materials help learners to keep their learning on track through quizzes, because the interactive learning materials can inform the users of their level of understanding through correction rates on the quizzes.

### 6.3 Research question 3

The third research question asks as follows:

Does the use of interactive materials affect the relationship between learning satisfaction and intention to apply learning contents with internal motivation, motivation for better assessment, critical and positive thinking skills, planning and organizing skills, as well as effort regulation?

In answering this research question, five hypotheses were tested. Moderation analysis was used to test these hypotheses. Two significant moderation effects are identified. First, the use of interactive materials affects the relationship between internal motivation and learning satisfaction and intention to apply learning contents positively. Second, the use of interactive materials affects the relationship between motivation for better assessment and learning satisfaction and intention to apply learning contents positively. This research question further investigates the reasons for the difference in learning satisfaction and intention to apply learning contents between two groups of teachers, which is identified in research question 2. This section explains these two significant moderation effects by referring to the literature, and the results are interpreted in the context of Mongolian primary school teachers. The local interpretation for each finding is based on the analysis of focus group discussions and interviews, for which the original data is included in Appendix 6, under the section “in relation to research question 3”. Further, reasons for the denied hypotheses are interpreted in section 6.4.

### 6.3.1 Hypotheses testing for research question 3

There are five hypotheses corresponding with research question 3 as shown below.

Hypothesis 3.1: The influence of teachers' internal motivation on learning satisfaction and intention to apply learning contents is stronger for teachers who utilize interactive materials (Carneiro et al., 2011).

Hypothesis 3.2: The influence of teachers' motivation for better assessment on learning satisfaction and intention to apply learning contents is stronger for teachers who utilize interactive materials (Cheng, 2014).

Hypothesis 3.3: The influence of teachers' planning and organizing skills on learning satisfaction and intention to apply learning contents is stronger for teachers who utilize interactive materials (Delen et al., 2014).

Hypothesis 3.4: The influence of teachers' critical and positive thinking skills on learning satisfaction and intention to apply learning contents is stronger for teachers who utilize interactive materials (Gharib et al., 2016).

Hypothesis 3.5: The influence of teachers' effort regulation on learning satisfaction and intention to apply learning contents is stronger for teachers who utilize interactive materials (Rakes & Dunn, 2010).

The analysis result for research question 3 supports two hypotheses. First, hypothesis 3.1 is supported, which states that the influence of teachers' internal motivation on learning satisfaction and intention to apply learning contents is stronger for teachers who utilize interactive materials (Carneiro et al., 2011). Second, hypothesis 3.2 is supported, which states that the influence of teachers' motivation for better assessment on learning satisfaction and intention to apply learning contents is stronger for teachers who utilize interactive materials (Cheng, 2014). The interviews and discussion with local Mongolian primary school teachers confirm the moderation effect of interactive materials on these two relationships.

6.3.2 The use of interactive materials positively affects the relationship between internal motivation and learning satisfaction and intention to apply learning contents.

Consistent with the study of Carneiro et al. (2011) with cases across European universities, this result supports the argument that learners' interest and curiosity enhance their satisfaction when the interactive materials support self-learning in a personalized environment. Further, this result agrees with the finding from Eom et al. (2006) where learner's self-motivation is found to promote learning satisfaction largely thanks to the meaningful instructor feedbacks in the case of university online education. In Mongolia, the analysis of the qualitative data collected from focus group discussions with local teachers shows that their learning satisfaction was higher when using interactive materials for two reasons. First, the interactive materials allow them to grasp the key concept more easily, helping to improve their professional competence and result in learning satisfaction. Second, time saving is another aspect that relates teachers' internal motivation to learning satisfaction. Specifically, motivated teachers utilize interactive materials to regularly assess their levels of understanding using the quiz and feedback features. In comparison, teachers feel that learning from written materials and videos lack an assessment aspect and a sense of self-reflection. Further, questions about specific pedagogies help teachers to reflect on their own teaching environment, resulting in them promoting student-centered lessons.

6.3.3 The use of interactive materials positively affects the relationship between motivation for better assessment and learning satisfaction and intention to apply learning contents.

This finding supports the research of Cheng (2014) which indicated that extrinsic motivation of learners using interactive e-learning materials positively influences their learning satisfaction. It explains how interactive features promote learners' ability to control the timing and display of the contents. Further, it functions to support real-time reciprocal communication, which helps learners to conduct self-assessment via instant feedback. This helps teachers build confidence in their

knowledge, resulting in learning satisfaction. Similarly, Garris et al. (2002) also indicated the benefit of feedback in interactive games to help extrinsically motivated learners to achieve a better learning outcome. Their research identified feedback function as a tool to clarify the gap between current status and standard, which helps learners exert more effort and finally influencing affective learning outcomes, such as satisfaction. The data analysis of model 3.2 (refer to section 5.4.2) show a rather small positive influence of interactive materials on the effect of motivation for better assessment on learning satisfaction. Further, the effect of motivation for better assessment on learning satisfaction is relatively low compared with other self-regulation processes in both teacher groups. Despite this finding shows a minor statistical significance, local teachers provided examples which indicated that interactive materials have two key characteristics that support the positive relationship between motivation for better assessment and learning satisfaction. First, interactive materials allow teachers to assess themselves without stress from peers because they can learn at their own personal pace. Second, spontaneous responses from the interactive material helps teachers to understand the learning progress. The challenging features of answering quizzes motivate them to get better scores. Thus, these personalized and timely features of interactive materials were found to induce teachers' motivation affecting learning satisfaction.

#### 6.4 Denied hypotheses for research question 2 and 3

The denied hypotheses for research question 2 shows that the teachers' internal motivation, planning and organizing skills, critical and positive thinking skills, and effort regulation are not significantly different between teachers who utilized interactive materials and the teachers who did not. The denied hypotheses for research question 3 shows that the use of interactive materials does not positively affect the relationships between learning satisfaction and planning and organizing skills, critical and positive thinking skills, and effort regulation. This section interprets and provides the reasons behind these findings.

First, teachers perceive similar level of internal motivation for teacher training regardless of whether they are using interactive materials or not. This is due to the

fact that rural teachers face scarce training materials for upgrading their skills. Therefore, teachers approach any training materials with a similar amount of internal motivation, as this is a basic attitude towards the rare training opportunities.

Second, teachers use planning and organizing skills in a similar fashion regardless of interactive materials. Plan and organization skills are especially relevant and important for teachers' profession. While clear about the contents to learn, teachers need to plan the learning tasks, understand the resources needed and make sure they are prepared before carrying out the learning tasks. Not only this applied to teachers' learning, it also holds true for teachers carrying out a class. A competent teacher is familiar with the contents of teaching, but also the planning of the delivery of these contents in coordination with the student's pace. Specifically, in self-development activities, teachers plan what is needed to learn, the length of learning, time of learning, and the place to learn. Since the procedures in using planning and organizing skills are the same with and without using interactive materials, teachers do not perceive significant gaps in learning satisfaction as a result of using this skill.

Third, teachers stated that the attitudes toward the use of critical and positive thinking skills in learning any teacher training materials are the same, thus they do not feel the difference in learning satisfaction as a result of using critical and positive thinking skills. Teachers are facing the constant need to acquire new knowledge, as they are the major vehicle of passing them to students. In the current world where change is universal, acquiring new knowledge is essential for teachers to carry out effective lessons. Practically, if teachers are not familiar with certain knowledge, they will use the critical thinking skills and think about the method to read more regarding the topic or go to peers to discuss the issue.

Fourth, teachers believe that their level of effort regulation does not differ due to the use of interactive materials. Teachers emphasize that making effort in teacher training is definitely needed especially when the training opportunities are not abundant. Based on the focus group discussion, it is mentioned that effort

regulation is considered an inherent quality needed for teachers. Teachers will make an effort in learning to upgrade their knowledge, as curriculum and pedagogies are constantly changing reflecting the progress in social and economic development. Therefore, effort regulation and its effect on learning satisfaction do not differ with regard to the use of interactive materials.

## Chapter 7: Conclusion

### 7.1 Research context and objectives

The importance of teachers' professional development is recognized worldwide. As a series of literature support that the professional development for teachers is both ongoing and dynamic, calling teachers to restructure their professional practices, deploy new pedagogies, and integrate emerging technologies into the classroom. In the process of continuous professional development, teachers are constantly facing the need to conduct self-learning to stay with this trend. Given the progressive nature of teachers' professional development, self-regulated learning is thus considered an important concept for teachers since it focuses on how a proactive learner direct his/her motivation and strategies in learning.

Along with the evolution of computer-mediated learning, the use of interactive materials is gaining attention in supporting learners' self-learning by influencing their motivation and helping them retain and organize new information. Multiple studies emphasized the importance of self-regulation skills including learning motivation and learning strategies when using interactive materials in distance learning context. In such learning environment, where guidance from instructor is limited, self-regulation skills are vital to help learners to achieve effective learning in a distance-learning context.

In Mongolia, professional development for primary school teachers is considered as an important domain to achieve quality education. In the course of educational reforms in Mongolia since 1990s, teachers' professional development has become the responsibility of local government. With this background, it becomes important to promote the teacher development on local school level, considering that Mongolia is one of the most dispersed country in the world. After 2000, the government of Mongolia established multiple legal frameworks to promote the use of ICT for teaching and learning, including teacher development in accordance with latest ICT development.

This study integrated the interactive materials for teachers' self-development. Specifically, this study applied self-regulated learning theory to investigate the self-learning processes in teacher training for primary school teachers in Mongolia. It contains two research objectives. The first research objective was to identify important self-regulation processes that affect teachers' learning outcome, measured by learning satisfaction and intention to apply learning contents.

The second research objective was to find out the influence of interactive materials on teachers' learning in self-development based on self-regulated learning theory. To achieve these two research objectives, three research questions and eleven hypotheses were formulated.

## 7.2 Important findings

There are two major findings to answer the research objectives.

First, three self-regulation processes are found to affect teachers' learning satisfaction and intention to apply learning contents. These are internal motivation, planning and organizing skills, and critical and positive thinking skills. This finding agrees with the current discussion supporting the importance of these three skills in affecting learner's learning satisfaction. For example, learner's internal motivation is found to be very important in promoting learning satisfaction and course completion rate in distance learning context, in which regular guidance and face-to-face communication are lacking. This study interpreted this finding in the Mongolian context. In term of internal motivation, local discussions with teachers illustrated that internally motivated teachers are informed and understand the value of training. With clear purposes and aims, teachers are more satisfied with the learning in teacher training. Regarding planning and organizing skills, as teacher training opportunities are still rare for the teachers in rural areas, teachers prepare for training and organize new knowledge during the training. Thus, planning and organizing skills of teachers become important factors. Such sound preparation could help them achieve better learning satisfaction from teacher training programs. As for critical and positive thinking skills, Mongolian teachers identify it to be a key skill in acquiring new knowledge, which links to teachers' learning satisfaction.

Teachers constantly need critical thinking skills to find alternative solutions when encountering issues in adopting new pedagogies, which is an important nature aspect of teaching as a profession.

These findings are important in Mongolian context, where multiple teacher training programs using ICT are implemented at local school levels under the government policy support, requiring teachers to conduct self-learning through their own effort. Through these findings, it is clear that teachers make most of the training opportunity by realizing the value of training, and apply learning strategies, which include planning and organizing skills, and critical and positive thinking skills to achieve higher learning satisfaction.

Second, the study showed the positive influence of interactive materials on the effect of teachers' internal motivation on learning satisfaction and intention to apply learning contents. Further, the study showed the positive influence of interactive materials on teachers' motivation for better assessment and its effect on learning satisfaction and intention to apply learning contents. The results were confirmed through the focus group discussions with 57 local primary school teachers.

Teachers who are interested in the topic find it easier to grasp key concepts easier in using interactive materials. The quizzes in interactive materials also help teachers self-reflect their learning progress, resulting in higher learning satisfaction.

Specifically, teachers reported that characteristics of interactive materials such as challenging feature through quizzes, spontaneous feedback, convenience of usage, and self-paced environment can support motivated teachers to achieve better learning satisfaction and intention to apply learning contents. Teachers attempt to answer quizzes in interactive materials correctly through gathering extra information, and become more curious with the topic. These learning experiences help teachers achieve higher learning satisfaction when using interactive materials. These findings support the discussion on the advantage of interactive materials in supporting learner's self-regulation processes and in promoting better learning outcomes (Gharib et al., 2016; Evans, Pruet, Chang, & Nino, 2014; Rakes & Dunn, 2010).

### 7.3 Implications

This section lays out academic implication and practical implications of this study. Regarding academic aspect, the study contributes in the following three ways. First, this study has provided empirical evidence to expand the use of self-regulated learning theory in teacher development. While large number of studies concentrate on student learning using SRL theory, SRL can be useful in investigating the learning of teachers. This study has also verified and localized the Motivated Strategies for Learning Outcome questionnaire in the Mongolian educational context.

Second, this study expands the use of SRL theory in a developing country's context. The study confirms the importance of self-regulation processes in a distance, teacher training context of a developing country where educational resources are comparatively limited.

Third, the study result demonstrates the positive impact of interactive learning materials from a cognitive point of view, this contribute to the need that the researches should investigate the learner-content interaction through understanding their motivation and learning processes, as suggested by Kennedy (2004) and Domagk et al. (2010) mentioned earlier. This is because large body of literature focused on the discussions of the interactive functions themselves but not how these functions affect learner's cognitive processes. This study in Mongolian context also add the evidence to support the advantage of interactive materials for its spontaneous feedback features.

From the practical aspect, the outcome of the study is particularly useful in designing interactive materials for teacher training programs. In order to examine the effect of interactive materials on teachers' self-learning, the study employed experimental design. Results show that interactive materials promote teachers' motivation for better assessment, and learning satisfaction and intention to apply learning contents. Further, interactive materials positively affects the influences of internal motivation and motivation for better assessment on learning satisfaction and intention to apply learning contents. Several characteristics were identified by

learners to be very useful, specifically, 1) the quiz format allowing learners to assess themselves at their own pace, 2) navigational features and summary of key knowledge, 3) spontaneous feedback with corresponding explanations on either right or wrong answers to quizzes. These findings suggest that educational practitioners could design and incorporate interactive learning materials with the above-mentioned characteristics for promoting learning motivation and learning satisfaction.

#### 7.4 Limitations and further research

There are two limitations in the methodology of this study. First, it should be noted that the data sample is 285 primary school teachers from one province in Mongolia. Thus, the study result may not be generalized to the entire cohort of primary school teachers in Mongolia. The study focused on schools in the rural part of Mongolia where contextual features are considered to be different from urban schools located in the capital city. However, as the sample size of this study represents 6% of the rural teacher population (MECSS, 2018), and reflecting a relatively homogeneous characteristic of the ethnic background of the Mongolian population, the study result can be considered a good illustration of rural primary school teachers in Mongolia. Future studies may expand the sample area covering urban school teachers to further understand the effect of interactive materials on self-regulated learning for teachers in Mongolia. In addition, future studies could investigate the influence of factors such as the reliability, affordability, and safety of electricity on teachers' use of interactive materials for self-development in both urban and rural schools. Moreover, subsequent studies could also investigate the use of interactive materials in other teacher cohorts, such as secondary school teachers, who may perceive and utilize interactive materials differently.

Further, it is also suggested to pay attention on how to deal with the randomization of the questions in the survey. The focus group discussion suggested that teachers are less familiar with randomized questions causing respondents to spend longer time to complete the survey. Therefore, more discussion is recommended with local experts on how to apply randomization of the questions when developing the

relevant survey. This is because that grouped question items may help teachers in answering the questions in an easier manner, especially for a lengthy survey.

Last but not least, this study relied on the parametric tests on the constructed variables that have continuous properties through summation of multiple 7-point Likert scale items. This study applied this approach because of its proven validity and popularity among social science and educational researchers ( Sullivan, Artino, & Jr, 2013, Beaumont, 2012; Norman, 2010; Carifio & Perla, 2007). This study relied on the parametric tests to enhance the comparability of the results with previous studies in the educational research field. However, it should be noted that future studies may also consider the use of non-parametric tests to analyze the data measured in Likert-scale, such as Categorical Principal Component Analysis (CATPCA) as a factor analysis technique and Mann-Whitney U-test as a population comparison technique. These methods do not rely on the distribution of the population and thus do not have the concern for the non-normally distributed data.

### 7.5 Final conclusion

In conclusion, this study focused on rural Mongolian primary school teachers' self-development in the distance learning context, where interactive materials were developed aiming at promoting teachers' self-learning. Self-regulated learning theory was applied in this study. By analyzing the data collected through the local survey on 285 primary school teachers, the study found out three important self-regulation processes that affects teachers' learning satisfaction and intention to apply learning contents. These are internal motivation, planning and organizing skills, and critical and positive thinking skills. Further, the study showed the positive influence of interactive materials on the effect of teachers' internal motivation on learning satisfaction and intention to apply learning contents. Moreover, the study showed the positive influence of interactive materials on teachers' motivation for better assessment and its effect on learning satisfaction and intention to apply learning contents. The data analysis results were presented to 57 rural primary school teachers in Mongolia, and the feedback from teachers was a

key to interpret the results in local educational context. Among all the interpretations, it is particularly worth noting that characteristics of interactive materials such as challenging features of quizzes, spontaneous feedback, convenience of usage and self-paced environment contribute to the quality of teachers' self-regulation processes in promoting better learning satisfaction and intention to apply learning contents. This study shows the positive influence of interactive learning materials on self-regulated learning for the professional development of primary school teachers in Mongolia, supporting future research and educational activities using interactive materials in Mongolia.

## References

- Adukaite, A., van Zyl, I., Er, Ş., & Cantoni, L. (2017). Teacher perceptions on the use of digital gamified learning in tourism education: The case of South African secondary schools. *Computers and Education, 111*, 172–190. <https://doi.org/10.1016/j.compedu.2017.04.008>
- Aguinis, H. (2003). *Regression Analysis for Categorical Moderators*. Guilford Press. Retrieved from <http://www.guilford.com/books/Regression-Analysis-for-Categorical-Moderators/Herman-Aguinis/9781572309692/contents>
- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology, 84*(3), 261–271. Retrieved from [http://groups.jyu.fi/sporticus/lahteet/LAHDE\\_17.pdf](http://groups.jyu.fi/sporticus/lahteet/LAHDE_17.pdf)
- Artino, A. R. (2007). Online military training using a social cognitive view of motivation and self-regulation to understand students' satisfaction, perceived learning, and choice. *The Quarterly Review of Distance Education, 8*(860), 191–202. <https://doi.org/Article>
- Beaumont, R. (2012). An introduction to Principal Component Analysis & Factor Analysis Using SPSS 19 and R ( psych package ). *Journal of Geophysical Research, (April)*, 24. Retrieved from <http://www.floppybunny.org/robin/web/virtualclassroom/stats/statistics2/pca1.pdf>
- Belsley, D., Kuh, E., & Welsch, R. (2005). Regression diagnostics: Identifying influential data and sources of collinearity. Retrieved from [https://books.google.co.jp/books?hl=zh-CN&lr=&id=GECBEUJVNe0C&oi=fnd&pg=PR7&dq=Regression+Diagnostics:+Identifying+Influential+Data+and+Sources+of+Collinearity&ots=b8d6j\\_9dD-&sig=zqjCBJ4JH8eobSva4lgnLd9-xy0](https://books.google.co.jp/books?hl=zh-CN&lr=&id=GECBEUJVNe0C&oi=fnd&pg=PR7&dq=Regression+Diagnostics:+Identifying+Influential+Data+and+Sources+of+Collinearity&ots=b8d6j_9dD-&sig=zqjCBJ4JH8eobSva4lgnLd9-xy0)
- Bernard, R. M., Abrami, P. C., Borokhovski, E., Wade, C. A., Tamim, R. M., Surkes, M. A., & Bethel, E. C. (2009). A Meta-Analysis of Three Types of

- Interaction Treatments in Distance Education. *Review of Educational Research*, 79(3), 1243–1289. <https://doi.org/10.3102/0034654309333844>
- Boekaerts, M., Pintrich, P. R., & Zeidner, M. (2000). *Handbook of Self-Regulation*. London: Academic Press.
- Borko, H. (2004). Professional Development and Teacher Learning: Mapping the Terrain. *Educational Researcher*, 33(8), 3–15. <https://doi.org/10.3102/0013189X033008003>
- Bransford, J., Brown, A., & Cocking, R. (1999). How people learn: Brain, mind, experience, and school. Retrieved from <http://doi.apa.org/psycinfo/1999-02807-000>
- Buckley, P., & Doyle, E. (2016). Gamification and student motivation. *Interactive Learning Environments*, 24(6), 1162–1175. <https://doi.org/10.1080/10494820.2014.964263>
- Butler, D. L., Lauscher, H. N., Jarvis-Selinger, S., & Beckingham, B. (2004). Collaboration and self-regulation in teachers' professional development. *Teaching and Teacher Education*, 20(5), 435–455. <https://doi.org/10.1016/j.tate.2004.04.003>
- Cairncross, S., & Mannion, M. (2001). Interactive Multimedia and Learning: Realizing the Benefits. *Innovations in Education and Teaching International*, 38(2), 156–164. <https://doi.org/10.1080/14703290110035428>
- Capper, J. (2001). The Emerging Market for On-line Learning: insights from the Corporate Sector. *European Journal of Education*, 36(2), 237–245. <https://doi.org/10.1111/1467-3435.00062>
- Carifio, J., & Perla, R. J. (2007). Ten Common Misunderstandings, Misconceptions, Persistent Myths and Urban Legends about Likert Scales and Likert Response Formats and their Antidotes. *Journal of Social Sciences*, 3(3), 106–116. <https://doi.org/10.3844/jssp.2007.106.116>

- Carneiro, R., Lefrere, P., Steffens, K., & Underwood, J. (2011). *Self-Regulated Learning in Technology Enhanced Learning Environments: An European Perspective*. Rotterdam, Netherlands: Sense Publishers. <https://doi.org/10.1007/978-94-6091-654-0>
- Chen, X., Barnett, D., & Stephens, C. (2013). Fad or future: The advantages and challenges of massive open online courses (MOOCs). *Research-to Practice* .... Retrieved from <https://www.lindenwood.edu/r2p/docs/ChenBarnettStephens.pdf>
- Cheng, Y.-M. (2014). Roles of interactivity and usage experience in e-learning acceptance: a longitudinal study. *International Journal of Web Information Systems*, 10(1), 2–23. <https://doi.org/10.1108/IJWIS-05-2013-0015>
- Cho, M.-H., & Shen, D. (2013). Self-regulation in online learning. *Distance Education*, 34(3), 290–301. <https://doi.org/10.1080/01587919.2013.835770>
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (1975). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. Retrieved from <https://books.google.com/books?hl=zh-CN&lr=&id=gkalyqTMXNEC&pgis=1>
- Coopey, E., Danahy, E., & Schneider, L. (2013). InterLACE. In *Proceedings of the 2013 conference on Computer supported cooperative work companion - CSCW '13* (p. 11). New York, New York, USA: ACM Press. <https://doi.org/10.1145/2441955.2441959>
- Delen, E., Liew, J., & Willson, V. (2014). Effects of interactivity and instructional scaffolding on learning: Self-regulation in online video-based environments. *Computers & Education*, 78, 312–320. <https://doi.org/10.1016/j.compedu.2014.06.018>
- Dettoni, G., & Persico, D. (2011). *Fostering Self-Regulated Learning through ICT*. Hershey, PA, United States of America: Information Science Reference, IGI Global. <https://doi.org/10.4018/978-1-61692-901-5>

- Diehr, P., & Lumley, T. (2002). The importance of the normality assumption in large public health data sets. *Annu. Rev. Public Health, 23*, 151–69.  
<https://doi.org/10.1146/annurev.publhealth.23.100901.140546>
- Domagk, S., Schwartz, R. N., & Plass, J. L. (2010). Interactivity in multimedia learning: An integrated model. *Computers in Human Behavior, 26*(5), 1024–1033.  
<https://doi.org/10.1016/j.chb.2010.03.003>
- Duffy, M. C., & Azevedo, R. (2015). Motivation matters: Interactions between achievement goals and agent scaffolding for self-regulated learning within an intelligent tutoring system. *Computers in Human Behavior, 52*, 338–348.  
<https://doi.org/10.1016/J.CHB.2015.05.041>
- Enabou, R., & Tirole, J. (2003). Intrinsic and Extrinsic Motivation. *Review of Economic Studies, 70*, 489–520. Retrieved from  
<https://www.princeton.edu/~rbenabou/papers/RES2003.pdf>
- Eom, S., Wen, H., & Ashill, N. (2006). The determinants of students' perceived learning outcomes and satisfaction in university online education: An empirical investigation. *Decision Sciences Journal Of, 4*(2), 215–235. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/j.1540-4609.2006.00114.x/full>
- Eom, W., & Reiser, R. (2000). The Effects of Self-Regulation and Instructional Control on Performance and Motivation in Computer-based Instruction. *International Journal of Instructional Media, 27*(3), 247–261. Retrieved from [https://www.researchgate.net/publication/234700329\\_The\\_Effects\\_of\\_Self-Regulation\\_and\\_Instructional\\_Control\\_on\\_Performance\\_and\\_Motivation\\_in\\_Computer-based\\_Instruction](https://www.researchgate.net/publication/234700329_The_Effects_of_Self-Regulation_and_Instructional_Control_on_Performance_and_Motivation_in_Computer-based_Instruction)
- Esquela-Kerscher, A., Krishna, N. K., Catalano, J. B., Lundberg, P. S., & Kerry, J. A. (2016). Design and Effectiveness of Self-Directed Interactive Learning Modules Based on PowerPoint™. *Medical Science Educator, 26*(1), 69–76.  
<https://doi.org/10.1007/s40670-015-0191-x>

- Evans, M. A., Pruett, J., Chang, M., & Nino, M. (2014). Designing Personalized Learning Products for Middle School Mathematics: The Case for Networked Learning Games. *Journal of Educational Technology Systems*, 42(3), 235–254. <https://doi.org/10.2190/ET.42.3.d>
- Finstad, K. (2010). Response Interpolation and Scale Sensitivity: Evidence Against 5-Point Scales. *Journal of Usability Studies*, 5(3), 104–110. Retrieved from <http://www.usabilityprofessionals.org>.
- Fullan, M. (2007). *The New Meaning of Educational Change*. New York: Teacher College Press. Retrieved from <http://books.google.com/books?hl=zh-CN&lr=&id=dvc84eFzKkkC&pgis=1>
- Garfield, C. A., & Bennett, H. Z. (1985). *Peak performance : mental training techniques of the world's greatest athletes*. Warner Books. Retrieved from [https://openlibrary.org/books/OL2864122M/Peak\\_performance](https://openlibrary.org/books/OL2864122M/Peak_performance)
- Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, Motivation, and Learning: A Research and Practice Model. *Simulation & Gaming*, 33(4), 441–467. <https://doi.org/10.1177/1046878102238607>
- Gharib, M., Zolfaghari, M., Mojtahedzadeh, R., Mohammadi, A., & Gharib, A. (2016). Promotion of critical thinking in e-learning: a qualitative study on the experiences of instructors and students. *Advances in Medical Education and Practice*, 7, 271–9. <https://doi.org/10.2147/AMEP.S105226>
- Government of Mongolia. (2006). Master Plan to Develop Education of Mongolia in 2006-2015. Retrieved April 5, 2018, from [http://planipolis.iiep.unesco.org/upload/Mongolia/Mongolia Education Master Plan 2006-2015.pdf](http://planipolis.iiep.unesco.org/upload/Mongolia/Mongolia_Education_Master_Plan_2006-2015.pdf)
- Haghparast, M., Nasaruddin, F. H., & Abdullah, N. (2014). Cultivating Critical Thinking Through E-learning Environment and Tools: A Review. *Procedia - Social and Behavioral Sciences*, 129, 527–535. <https://doi.org/10.1016/j.sbspro.2014.03.710>

- Hair, J. J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate Data Analysis* (7th ed.). New York: Prentice Hall.
- Hannafin, M. J. (1989). Interaction Strategies and Emerging Instructional Technologies: Psychological Perspectives. *Canadian Journal of Educational Communication*, *18*(3), 167–179. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.124.8434&rep=rep1&type=pdf#page=9>
- Hannafin, M. J., & Peck, K. L. (1988). *The design, development, and evaluation of instructional software*. *Computers & Education* (Vol. 14). [https://doi.org/10.1016/0360-1315\(90\)90011-U](https://doi.org/10.1016/0360-1315(90)90011-U)
- Hardré, P. (2008). Designing Effective Learning Environments for Continuing Education. *Performance Improvement Quarterly*, *14*(3), 43–74. <https://doi.org/10.1111/j.1937-8327.2001.tb00218.x>
- Hayes, A. (2013). Introduction to mediation, moderation, and conditional process analysis. *New York, NY: Guilford*, 3–4. <https://doi.org/978-1-60918-230-4>
- Henry, S. K., Scott, J. A., Wells, J., Skobel, B., Jones, A., Cross, S., ... Blackstone, T. (1999). Linking University and Teacher Communities: A “Think Tank” Model of Professional Development. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, *22*(4), 251–268. <https://doi.org/10.1177/088840649902200406>
- Hwang, Y. S., & Vrongistinos, K. (2002). Elementary in-service teachers’ self-regulated learning strategies related to their academic achievements. *Journal of Instructional Psychology*, *29*(3), 147–154. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=psych&AN=2002-18339-003&lang=ja&site=ehost-live%5Cnyhwang@csusb.edu>
- Information Communications Technology and Post Authority of Mongolia. (2011). *The White Paper on ICT Development of Mongolia*. Ulaanbaatar, Mongolia.

- Isikoglu, N., Basturk, R., & Karaca, F. (2009). Assessing in-service teachers' instructional beliefs about student-centered education: A Turkish perspective. *Teaching and Teacher Education, 25*(2), 350–356.  
<https://doi.org/10.1016/j.tate.2008.08.004>
- Jaccard, J., & Turrisi, R. (2003). *Interaction effects in multiple regression. Quantitative applications in the social sciences*. Sage Publications.  
[https://doi.org/10.1300/J079v16n01\\_09](https://doi.org/10.1300/J079v16n01_09)
- Johnson-Graham, L. C. (2012). Saving the World for All the Wrong Reasons: Extrinsic Motivation Reduces Favorability of Prosocial Acts. *Prosocial Acts, 35*. Retrieved from [https://scholar.colorado.edu/psyc\\_gradetds](https://scholar.colorado.edu/psyc_gradetds)
- Johnson, R. D., Gueutal, H., & Falbe, C. M. (2009). Technology, trainees, metacognitive activity and e - learning effectiveness. *Journal of Managerial Psychology, 24*(6), 545–566. <https://doi.org/10.1108/02683940910974125>
- Kang, B., & Tan, S. H. (2014). Interactive Games: Intrinsic and Extrinsic Motivation, Achievement, and Satisfaction. *Journal of Management and Strategy, 5*(110), 1923–3965. <https://doi.org/10.5430/jms.v5n4p110>
- Keller, J. M. (2008). First principles of motivation to learn and e<sup>3</sup> - learning. *Distance Education, 29*(2), 175–185.  
<https://doi.org/10.1080/01587910802154970>
- Kennedy, G. E. (2004). Promoting Cognition in Multimedia Interactivity Research. *Journal of Interactive Learning Research, 15*(1), 43–61. Retrieved from <http://ezproxy.massey.ac.nz/login?url=http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,cookie,url,uid&db=eric&AN=EJ726292&site=ehost-live>
- Koller, D. (2012). What We're Learning from Online Education. Retrieved May 17, 2015, from [http://www.learningexecutive.com/CLLC/2014/gA\\_WhatWeAreLearningFromOnlineEducation\\_chi.pdf](http://www.learningexecutive.com/CLLC/2014/gA_WhatWeAreLearningFromOnlineEducation_chi.pdf)

- Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers & Education*, 78, 160–173. <https://doi.org/10.1016/J.COMPEDU.2014.05.009>
- Kramarski, B., & Gutman, M. (2006). How can self-regulated learning be supported in mathematical E-learning environments? *Journal of Computer Assisted Learning*, 22(1), 24–33. <https://doi.org/10.1111/j.1365-2729.2006.00157.x>
- Kramarski, B., & Michalsky, T. (2009). Investigating preservice teachers' professional growth in self-regulated learning environments. *Journal of Educational Psychology*, 101(1), 161–175. <https://doi.org/10.1037/a0013101>
- Krause, U.-M., Stark, R., & Mandl, H. (2009). The effects of cooperative learning and feedback on e-learning in statistics. *Learning and Instruction*, 19(2), 158–170. <https://doi.org/10.1016/j.learninstruc.2008.03.003>
- Kuo, Y. C., Walker, A. E., Schroder, K. E. E., & Belland, B. R. (2014). Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses. *Internet and Higher Education*, 20, 35–50. <https://doi.org/10.1016/j.iheduc.2013.10.001>
- Law, K. M. Y., Lee, V. C. S., & Yu, Y. T. T. (2010). Learning motivation in e-learning facilitated computer programming courses. *Computers and Education*, 55(1), 218–228. <https://doi.org/10.1016/j.compedu.2010.01.007>
- Leung, S.-O. (2011). A Comparison of Psychometric Properties and Normality in 4-, 5-, 6-, and 11-Point Likert Scales. *Journal of Social Service Research*, 37(4), 412–421. <https://doi.org/10.1080/01488376.2011.580697>
- Liaw, S.-S., & Huang, H.-M. (2013). Perceived satisfaction, perceived usefulness and interactive learning environments as predictors to self-regulation in e-learning environments. *Computers & Education*, 60(1), 14–24. <https://doi.org/10.1016/j.compedu.2012.07.015>

- Littlejohn, A., Hood, N., Milligan, C., & Mustain, P. (2016). Learning in MOOCs: Motivations and self-regulated learning in MOOCs. *The Internet and Higher Education, 29*, 40–48. <https://doi.org/10.1016/j.iheduc.2015.12.003>
- Lynch, R., & Dembo, M. (2004). The Relationship Between Self-Regulation and Online Learning in a Blended Learning Context. *The International Review of Research in Open and Distributed Learning, 5*(2). <https://doi.org/10.19173/irrodl.v5i2.189>
- McDonough, K., & Foote, J. A. (2015). The impact of individual and shared clicker use on students' collaborative learning. *Computers & Education, 86*, 236–249. <https://doi.org/10.1016/J.COMPEDU.2015.08.009>
- McKeachie, W. J., Duncan, T. G., & McKeachie, W. J. (2010). The Making of the Motivated Strategies for Learning Questionnaire. *Educational Psychologist, 40*(2), 107–115. [https://doi.org/10.1207/s15326985ep4002\\_6](https://doi.org/10.1207/s15326985ep4002_6)
- MECSS. (2012a). *Action Plan of the Information and Communication Technology In Education Policy (2012-2016)* (No. Annex No.2 to the Decree No. A24). Ulaanbaatar, Mongolia.
- MECSS. (2012b). *Information and Communication Technology In Education Policy (2012-2016)* (No. Annex No.1 to the Decree No.A24). Ulaanbaatar, Mongolia.
- MECSS. (2014). Core curriculum. Ulaanbaatar. Retrieved from [http://www.meds.gov.mn/data/1409/Tsum\\_booklet.pdf](http://www.meds.gov.mn/data/1409/Tsum_booklet.pdf)
- MECSS. (2018). Statistics on Education Sector (2016-2017). Retrieved March 27, 2018, from <http://www.mecss.gov.mn/EBSsta2017>
- Ministry of Education Culture Science and Sports. (2015). Web Portal for School. Retrieved November 24, 2017, from <http://econtent.edu.mn/content/library.html>
- Mon-Educ Consulting LLC. (2017). *Report of the impact survey of "Quality improvement of primary education teachers through development of training materials using ICT" project funded by JICA, Japan*. Ulaanbaatar. Retrieved from

[https://drive.google.com/file/d/0B1esJ\\_eT8Ma5WVdpbm44TmRkZGs/view](https://drive.google.com/file/d/0B1esJ_eT8Ma5WVdpbm44TmRkZGs/view)

- Moore, M. G. (1989). Editorial: three types of interaction. *American Journal of Distance Education*, 3(2), 1–7. <https://doi.org/10.1080/08923648909526659>
- Moos, D. C. (2010). Nonlinear technology: Changing the conception of extrinsic motivation? *Computers & Education*, 55(4), 1640–1650. <https://doi.org/10.1016/j.compedu.2010.07.006>
- Moreno, R., & Mayer, R. E. (2007). Role of Guidance, Reflection, and Interactivity in an Agent-Based Multimedia Game. *Journal of Educational Psychology*, 97(1), 117–128. <https://doi.org/10.1037/0022-0663.97.1.117>
- Moshinskie, J. (2001). How to keep e-learners from e-scaping. *Performance Improvement*, 40(6), 30–37. <https://doi.org/10.1002/pfi.4140400607>
- Nada Dabbagh, A. K., Dabbagh, N., & Kitsantas, A. (2004). Supporting Self-Regulation in Student-Centered Web-Based Learning Environments. *International Journal on E-Learning*, 3(1), 40–47. Retrieved from <https://eric.ed.gov/?id=EJ723806>
- Nobre, J. S., & da Motta Singer, J. (2007). Residual analysis for linear mixed models. *Biometrical Journal. Biometrische Zeitschrift*, 49(6), 863–75. <https://doi.org/10.1002/bimj.200610341>
- Norman, G. (2010). Likert scales, levels of measurement and the “laws” of statistics. *Advances in Health Sciences Education*, 15(5), 625–632. <https://doi.org/10.1007/s10459-010-9222-y>
- Osborne, J., & Waters, E. (2002). Four assumptions of multiple regression that researchers should always test. ... *Assessment, Research & ...* Retrieved from <http://www-psychology.concordia.ca/fac/kline/495/osborne.pdf>
- Park, I., & Hannafin, M. J. (1993). Empirically-based guidelines for the design of interactive multimedia. *Educational Technology Research and Development*, 41(3), 63–85. <https://doi.org/10.1007/BF02297358>

- Perry, N. E., Walton, C., & Calder, K. (1999). Teachers Developing Assessments of Early Literacy: A Community of Practice Project. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, 22(4), 218–233.  
<https://doi.org/10.1177/088840649902200404>
- Pintrich, P. (2004). A Conceptual Framework for Assessing Motivation and Self-Regulated Learning in College Students. *Educational Psychology Review*, 16(4), 385–407. <https://doi.org/10.1007/s10648-004-0006-x>
- Pintrich, P. R. (2000). The Role of Goal Orientation in Self-Regulated Learning. *Handbook of Self-Regulation*, 451–502. <https://doi.org/10.1016/B978-012109890-2/50043-3>
- Pintrich, P. R., & De Groot, E. V. (1990). Motivational and Self-Regulated Learning Components of Classroom Academic Performance. *Journal of Educational Psychology*, 82(1), 33–40. <https://doi.org/10.1037/0022-0663.82.1.33>
- Pintrich, P., & Schunk, D. (1996). The Role of Expectancy and Self-Efficacy Beliefs. Retrieved December 26, 2017, from <https://www.uky.edu/~eushe2/Pajares/PS.html>
- Pintrich, P., Smith, D., Garcia, T., & McKeachie, W. (1991). A Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ). Retrieved April 5, 2018, from <https://files.eric.ed.gov/fulltext/ED338122.pdf>
- Pintz, C., & Posey, L. (2013). Preparing students for graduate study: An eLearning approach. *Nurse Education Today*, 33(7), 734–738.  
<https://doi.org/10.1016/j.nedt.2012.11.020>
- Pomfret, R. (1999). Transition and democracy in Mongolia. Retrieved July 27, 2015, from <https://www.adelaide.edu.au/cies/documents/papers/9907.pdf>
- Rakes, G. C., & Dunn, K. E. (2010). The impact of online graduate students' motivation and self-regulation on academic procrastination. *Journal of*

- Interactive Online Learning*, 9(1), 78–93. Retrieved from [http://www.anitacrawley.net/Articles/Rakes self reg and procrastination.pdf](http://www.anitacrawley.net/Articles/Rakes%20self%20reg%20and%20procrastination.pdf)
- Rennie, L. J. (2001). Teacher Collaboration in Curriculum Change: The Implementation of Technology Education in the Primary School. *Research in Science Education*, 31(1), 49–69. <https://doi.org/10.1023/A:1012622631077>
- Rensis Likert. (1932). *A technique for the measurement of attitudes*. New York: New York University. Retrieved from [https://legacy.voteview.com/pdf/Likert\\_1932.pdf](https://legacy.voteview.com/pdf/Likert_1932.pdf)
- Rogers, Y., & Scaife, M. (1998). How Can Interactive Multimedia Facilitate Learning?
- Rothman, K. J., Greenland, S., & Walker, A. M. (1980). Concepts of interaction. *American Journal of Epidemiology*, 112(4), 467–470. <https://doi.org/10.1093/oxfordjournals.aje.a113015>
- Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting Self-Regulation in Science Education: Metacognition as Part of a Broader Perspective on Learning. *Research in Science Education*, 36(1–2), 111–139. <https://doi.org/10.1007/s11165-005-3917-8>
- Schunk, D. H., & Swartz, C. W. (1993). Goals and Progress Feedback: Effects on Self-Efficacy and Writing Achievement. *Contemporary Educational Psychology*, 18(3), 337–354. Retrieved from [https://libres.uncg.edu/ir/uncg/f/D\\_Schunk\\_Goals\\_1993.pdf](https://libres.uncg.edu/ir/uncg/f/D_Schunk_Goals_1993.pdf)
- Schwier, R., & Misanchuk, E. R. (1993). *Interactive multimedia instruction*. Englewood Cliffs, New Jersey: Educational Technology Publications. Retrieved from <https://books.google.co.jp/books?hl=ja&lr=&id=q9HKqrx-7o4C&oi=fnd&pg=PR9&dq=interactive+multimedia+instruction&ots=sQz0Zgf-Lw&sig=4Qb6cE6wW3CqIJWY--101hs3qm8>
- Selvi, K. (2010). Motivating factors in online courses. *Procedia Social and Behavioral Sciences*, 2, 819–824. <https://doi.org/10.1016/j.sbspro.2010.03.110>

- Sims, R. (1997). Interactivity: A forgotten art? *Computers in Human Behavior*, 13(2), 157–180. [https://doi.org/10.1016/S0747-5632\(97\)00004-6](https://doi.org/10.1016/S0747-5632(97)00004-6)
- Smith, H. L. B. (2016). Professional Development Effects on Teachers' Self-Regulated Learning. Retrieved from <https://jscholarship.library.jhu.edu/handle/1774.2/40336>
- Somers, M. J. (1995). Organizational commitment, turnover and absenteeism: An examination of direct and interaction effects. *Journal of Organizational Behavior*, 16(1), 49–58. <https://doi.org/10.1002/job.4030160107>
- Stevanović, N. (2014). Effects of motivation on performance of students in MOOC. *Sinteza*, 418–422. <https://doi.org/10.15308/SInteZa-2014-418-422>
- Sullivan, G. M., & Artino, A. R. (2013). Analyzing and Interpreting Data From Likert-Type Scales. *Journal of Graduate Medical Education*, 5(4), 541–542. <https://doi.org/10.4300/JGME-5-4-18>
- Toby Mordkoff, J. (2016). The Assumption(s) of Normality. Retrieved from [http://www2.psychology.uiowa.edu/faculty/mordkoff/GradStats/part 1/I.07 normal.pdf](http://www2.psychology.uiowa.edu/faculty/mordkoff/GradStats/part%201/I.07normal.pdf)
- Tokyo Institute of Technology. (2012). *Sustainable use of ICT for improving the quality of primary education in rural Mongolia*. Tokyo. Retrieved from <http://www.yamaguchi.gsic.titech.ac.jp/curr/>
- UNDP. (2013). Formulating the post-2015 development agenda. Retrieved July 26, 2015, from [http://www.un-mongolia.mn/new/wp-content/uploads/2014/12/Post-2015\\_Eng.pdf](http://www.un-mongolia.mn/new/wp-content/uploads/2014/12/Post-2015_Eng.pdf)
- UNDP. (2014). Multidimensional Poverty Index (MPI). Retrieved July 26, 2015, from <http://hdr.undp.org/en/content/table-6-multidimensional-poverty-index-mpi>
- UNDP. (2016). *Human Development Report 2016 - Mongolia*. Retrieved from [http://hdr.undp.org/sites/all/themes/hdr\\_theme/country-notes/MNG.pdf](http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/MNG.pdf)

- UNDP in Mongolia. (2013). About Mongolia. Retrieved July 26, 2015, from <http://www.mn.undp.org/content/mongolia/en/home/countryinfo/>
- UNESCO-IBE. (2011). *World Data on Education - Mongolia, VII Ed. 2010/11*. Geneva.
- UNESCO. (2018). *Positioning ICT in Education to Achieve the Education 2030 Agenda in Asia and the Pacific: Recommendations for a Regional Strategy*. Paris. Retrieved from <http://bangkok.unesco.org/content/positioning-ict-education-achieve-education-2030-agenda-asia-and-pacific-recommendations>
- UNESCO Institute for Statistics. (2014). Mongolia country profiles. Retrieved July 27, 2015, from <http://www.uis.unesco.org/DataCentre/Pages/country-profile.aspx?code=MNG&sector=lit>
- Violante, M. G., & Vezzetti, E. (2015). Virtual interactive E-learning application: An evaluation of the student satisfaction. *Computer Applications in Engineering Education, 23*(1), 72–91. <https://doi.org/10.1002/cae.21580>
- Vorel, M. (2014). Maps of Mongolia. Retrieved July 26, 2015, from <http://www.mongols.eu/maps-of-mongolia/>
- Wang, C. H., Shannon, D. M., & Ross, M. E. (2013). Students' characteristics, self-regulated learning, technology self-efficacy, and course outcomes in online learning. *Distance Education, 34*(3), 302–323. <https://doi.org/10.1080/01587919.2013.835779>
- Wesley, P. W., & Buysse, V. (2001). Communities of Practice: Expanding Professional Roles to Promote Reflection and Shared Inquiry. *Topics in Early Childhood Special Education, 21*(2), 114–123. <https://doi.org/10.1177/027112140102100205>
- Wolters, C. A., & Pintrich, P. R. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. *Instructional Science, 26*(1/2), 27–47. <https://doi.org/10.1023/A:1003035929216>

- Young, J. D. (1996). The effect of self-regulated learning strategies on performance in learner controlled computer-based instruction. *Educational Technology Research and Development*, 44(2), 17–27. <https://doi.org/10.1007/BF02300538>
- Zhao, X., & Namasivayam, K. (2009). Posttraining Self-Efficacy, Job Involvement, and Training Effectiveness in the Hospitality Industry. *Journal of Human Resources in Hospitality & Tourism*, 8(2), 137–152. <https://doi.org/10.1080/15332840802269767>
- Zimmerman, B. J. (1990). Self-Regulated Learning and Academic Achievement: An Overview. *Educational Psychologist*. <https://doi.org/10.1207/s15326985ep2501>
- Zimmerman, B. J. (2000). Attaining Self-Regulation. In *Handbook of Self-Regulation* (pp. 13–39). Elsevier. <https://doi.org/10.1016/B978-012109890-2/50031-7>
- Zimmerman, B. J. (2002). Becoming a Self-Regulated Learner: An Overview. *Theory Into Practice*, 41(2), 64–70. [https://doi.org/10.1207/s15430421tip4102\\_2](https://doi.org/10.1207/s15430421tip4102_2)
- Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-Motivation for Academic Attainment: The Role of Self-Efficacy Beliefs and Personal Goal Setting. *American Educational Research Journal*, 29(3), 663–676. <https://doi.org/10.3102/00028312029003663>
- Zimmerman, B. J., & Kitsantas, A. (1997). Developmental phases in self-regulation: Shifting from process goals to outcome goals. *Journal of Educational Psychology*, 89(1), 29–36. <https://doi.org/10.1037/0022-0663.89.1.29>

## Appendix 1: Screenshots of interactive materials

Дүрслэх урлаг, технологи  
**Асуулт 4**

Өөрийн зөв гэж бодсон нэг хариулыг сонгоно уу.

**Метрийн давтамж гэж юу вэ?**

- Нэгэн тэрлийн хэлбэр, хэлбэрийн элемент, хэмжээ тасралтгүй давтагдахгүй байгааг нь хэмнэлт давтамж гэж нэрлэдэг.
- Нэгэн тэрлийн хэлбэр, хэлбэрийн элемент, хэмжээ тасралтгүй давтагдаж байгааг нь метрийн давтамж гэнэ.

Шалгах


5 / 34

### Multiple choice questions (MCQ)

Дүрслэх урлаг, технологи  
**Асуулт 5**

Өөрийн зөв гэж бодсон нэг хариулыг сонгоно уу.

**Амьтдын дүрсийг ямар давтамж ашиглаж хийсэн бэ?**



- Хэмнэлт давтамж
- Метрийн давтамж

Шалгах

6 / 34


### MCQ with graphics

Дүрслэх урлаг, технологи

### Асуулт 7

Хоёр хүүхдийн зурсан зургийн аль нь сэдэвт, аль нь зураасан зураг вэ?

"Жин үд" зураасан зураг "Нүүдэл" сэдэвт зураг



8 / 34

Drag and drop question

Дүрслэх урлаг, технологи

### Асуулт 10

Өөрийн зөв гэж бодсон нэг хариултыг сонгоно уу.

Үндсэн өнгөд ямар ямар өнгө ордог вэ? 3 өнгийг сонгоорой.

- Улаан
- Хар
- Шар
- Цагаан
- Хөх

Шалгах

11 / 34

MCQ with multiple correct answers

Дүрслэх урлаг, технологи  
**Асуулт 13**

Дүрслэх урлаг ямар үйл ажиллагаагаар хэрэгжих вэ?

Тохирох үгийг цэнхрэн оруулж өгүүлбэрийг гүйцээж үү.


өөрийн бүтээсэн зүйлдээ үнэлгээ дүгнэлт өгөх

холбогдолтой мэдээллийг олж авах

зохион бүтээх түүнээ унших

13 / 34

Fill in the blank question

Дүрслэх урлаг, технологи  
**Асуулт 27**

Өөрийн зөв гэж бодсон нэг хариултыг сонгоно уу.

**Загварчлалын хэлбэр, хэмжээ, эд ангийн тоо, байрлалыг өөрчлөх аргыг хэрэглэснээр юмсын хэлбэрт өөрчлөлт ордог. Доорх зурагт загварчлалын ямар аргыг хэрэглэсэн бэ? Зөвхөн 1-ийг сонгоорой.**



Хэмжээг өөрчилсөн  
 Хэлбэрийг өөрчилсөн  
 Эд ангийн тоог өөрчилсөн  
 Эд ангийн байрлалыг өөрчилсөн

Таны хариулт буруу байна. Та дахин шалгана уу.

**Зөв хариулт**

Зохион бүтээж байгаа зүйлийнхээ хэлбэр, хэмжээ, эд ангийн тоо, байрлалыг оновчтой болгоно. Энэ үйл ажиллагааг загварчлалын аргын тусламжтайгаар гүйцэтгэдэг. /Д.Хөхөө, Х.Төмөрхуяг Дизайн товч тайлбар толь УБ., 1998. х 21-ийн зураг орно. Монгол Улсын Боловсролын Их Сургууль. Бага ангийн багшийн гарын авлага. II. Хянан тохиолдуулж эмхэтгэсэн Н.Жадамба. УБ., 2011. Х 143-144-өөс "Загварчлал"-ын аргын тухай уншина уу?

29 / 34


Detailed spontaneous feedback below the quiz for either correct or incorrect answers


### Асуулт 9


Дараах цонхонд тохирох аргуудыг тохируулан сруулна уу. Эхний хариултыг цонхонд байрлуулсаны дараа дараагийн хариулт гарч ирэх болно.

Асуулт тавих аргын сэргээн сануулах үеийн шатуудыг дарааллын дагуу зөв байрлуулна уу.

Сонсох шат. Энэ шатанд суралцагчдын таамаглал буюу бичсэн зүйлсийг сонгож ярилцана.

а. 

б. 

в. 

Шалгах

Arrange the sequence

## Appendix 2: The survey questionnaire applied in this study

Note: questionnaire is administered in two versions, teachers in experimental group received the questionnaire with questions 6 – 9 in Part A, teachers in control group received the questionnaire without these questions.

### Survey on in-service teacher training activities

This survey consists of four main parts, we have formulated the following parts in this survey: first part is about your background information, second part is about your learning motivation for training activities, third part is on your learning approaches for teacher training, and the last part is about the impact of the teacher training. Survey itself has a wide context, and you will be spending approximately 30 minutes to complete the survey. We appreciate for your time and participation for being involved in this survey. This survey material will be used only for research purposes, and your privacy will be strictly kept confidential. Your feedback is very important to improve the training activities in the future, we greatly appreciate your participation. Thank you very much. Tokyo Institute of Technology.

Part A. Demographics

1. Location of your school  
[1] Aimag center [2] Soum
2. Gender  
[1] Female [2] Male
3. Your age: \_\_\_\_\_
4. Years of service as teacher: \_\_\_\_\_
5. Type of your school  
[1] Primary school [2] Complex school
6. How often do you use interactive material?  
[1] Daily [2] Several times a week [3] Once a week [4] Few times a month  
[5] More seldom [6] Never
7. Where do you use interactive material?  
[1] In the school [2] At home [3] At other places (please indicate) \_\_\_\_\_
8. Do you use interactive material individually or in groups?  
[1] Individually [2] In groups
9. What was your impression of the interactive learning material?
  - 1) Usefulness of the contents  
[1] Very dissatisfied [2] Dissatisfied [3] Neutral [4] Satisfied [5] Very satisfied
  - 2) Easiness to understand the contents  
[1] Very dissatisfied [2] Dissatisfied [3] Neutral [4] Satisfied [5] Very satisfied
  - 3) Easiness to operate the interactive material  
[1] Very dissatisfied [2] Dissatisfied [3] Neutral [4] Satisfied [5] Very satisfied
  - 4) Likelihood to continue using the interactive material  
[1] Very unlikely [2] Unlikely [3] Neutral [4] Likely [5] Very likely
  - 5) Degree of willingness to recommend to a friend  
[1] Very unlikely [2] Unlikely [3] Neutral [4] Likely [5] Very likely
  - 6) Effectiveness of interactive learning materials for teacher training  
[1] Very dissatisfied [2] Dissatisfied [3] Neutral [4] Satisfied [5] Very satisfied
  - 7) Level of satisfaction  
[1] Very dissatisfied [2] Dissatisfied [3] Neutral [4] Satisfied [5] Very satisfied

Part B. Motivation

The following questions ask about your motivation and attitudes about the JICA project teacher training. There are no right or wrong answers, please answer reflecting your experiences. Use the scale below to answer the questions. If you think the statement is very true for you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you. This questionnaire is to receive feedback from you to improve the training activities in the future. Your response will make a difference for the future training. Thank you very much for your cooperation. Tokyo Institute of Technology.

	1	2	3	4	5	6	7
	Strongly disagree	Mostly disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Mostly agree	Strongly agree
1. In teacher training, I prefer the materials that really challenge me so I can learn new things.	1	2	3	4	5	6	7
2. If I study in appropriate ways, then I will be able to learn the materials in teacher training.	1	2	3	4	5	6	7
3. I think I will be able to use what I learn in teacher training in teaching activities.	1	2	3	4	5	6	7
4. Getting a good assessment in this training is the most satisfying thing for me right now.	1	2	3	4	5	6	7
5. It is my own fault if I don't learn the materials in teacher training.	1	2	3	4	5	6	7
6. It is important for me to learn the materials in teacher training.	1	2	3	4	5	6	7
7. I'm confident I can understand the basic concepts taught in teacher training.	1	2	3	4	5	6	7
8. If I can, I want to get better assessment in teacher training than most of the other teachers.	1	2	3	4	5	6	7
9. I'm confident I can understand the most complex materials presented in teacher training.	1	2	3	4	5	6	7
10. In teacher training, I prefer the materials that arouses my curiosity, even if it is difficult to learn.	1	2	3	4	5	6	7
11. I am very interested in the content area of the teacher training materials.	1	2	3	4	5	6	7
12. If I try hard enough, then I will understand the teacher training materials.	1	2	3	4	5	6	7
13. I expect to do well in this teacher training.	1	2	3	4	5	6	7
14. The most satisfying thing for me in teacher training is trying to understand the content as thoroughly as possible.	1	2	3	4	5	6	7
15. I think the materials in teacher training are useful for me to learn.	1	2	3	4	5	6	7

- |                                                                                                            |   |   |   |   |   |   |   |
|------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|
| 16. I'm certain I can master the skills being taught in this teacher training.                             | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 17. Considering the difficulty of teacher training and my skills, I think I will do well in this training. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Part C. Learning Strategies

The following questions ask about your learning strategies and study skills for the JICA project teacher training. There are no right or wrong answers, please answer the questions about how you study in this teacher training reflecting your experiences. Please utilize the same scale to answer the remaining questions. If you think the statement is very true of you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you. This questionnaire is to receive feedback from you to improve the training activities in the future. Your response will make a difference for the future training. Thank you very much for your cooperation. Tokyo Institute of Technology.

	1	2	3	4	5	6	7				
	Strongly disagree	Mostly disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Mostly agree	Strongly agree				
18. When I study the materials for teacher training, I outline the material to help me organize my thoughts.					1	2	3	4	5	6	7
19. During training sessions, I often miss important points because I'm thinking of other things.					1	2	3	4	5	6	7
20. When studying for teacher training, I often try to explain the material to my colleague or a friend.					1	2	3	4	5	6	7
21. I usually study in a place where I can concentrate on teacher training.					1	2	3	4	5	6	7
22. When studying for teacher training, I make up questions to help focus my reading.					1	2	3	4	5	6	7
23. I often feel so lazy or bored when I study for teacher training that I quit before I finish what I planned to do.					1	2	3	4	5	6	7
24. I often find myself questioning things I hear or read in teacher training to decide if I find them convincing.					1	2	3	4	5	6	7
25. Even if I have trouble learning the material in teacher training, I try to do the work on my own, without help from anyone.					1	2	3	4	5	6	7
26. When I study for teacher training, I go through the training materials and my notes and try to find the most important ideas.					1	2	3	4	5	6	7
27. I make good use of my study time for teacher training.					1	2	3	4	5	6	7
28. If teacher training materials are difficult to understand, I change the way I read the material.					1	2	3	4	5	6	7
29. I try to work with other teachers from school to complete the training assignments.					1	2	3	4	5	6	7

- |                                                                                                                                                                                                 |   |   |   |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|
| 30. When studying for the teacher training materials, I read my training notes and the training materials over and over again.                                                                  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 31. When a theory, interpretation, or conclusion is presented in teacher training or in the training materials, I try to decide if there is good supporting evidence.                           | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 32. I work hard to do well in teacher training even if I don't like what we are doing.                                                                                                          | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 33. I make simple charts, diagrams, or tables to help me organize teacher training material.                                                                                                    | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 34. When studying for teacher training, I often set aside time to discuss the teacher training material with a group of teachers from school.                                                   | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 35. I treat the teacher training material as a starting point and try to develop my own ideas about it.                                                                                         | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 36. When I study for this training, I pull together information from different sources, such as teacher training seminars, readings, and discussions.                                           | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 37. Before I study new teacher training material thoroughly, I often skim it to see how it is organized.                                                                                        | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 38. I often find that I have been reading for teacher training materials but don't know what it was all about.                                                                                  | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 39. I ask the training manager or the methodologist to clarify concepts I don't understand well.                                                                                                | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 40. I memorize key words to remind me of important concepts in teacher training.                                                                                                                | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 41. 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 teacher training.                                          | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 42. When I study for teacher training, I go over my notes and make an outline of important concepts.                                                                                            | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 43. When studying for teacher training, I try to relate the training material to what I already know.                                                                                           | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 44. I try to play around with ideas of my own related to what I am learning in teacher training.                                                                                                | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 45. When I study for this training, I write brief summaries of the main ideas from the teacher training materials.                                                                              | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 46. When I can't understand the teacher training material, I ask another teacher who is studying teacher training material for help.                                                            | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 47. I try to understand the teacher training materials by making connections between the teacher training guideline and the concepts from the teacher training VCDs (and interactive material). | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

- |                                                                                                                               |   |   |   |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|
| 48. Whenever I read or hear an assertion or conclusion in the teacher training material, I think about possible alternatives. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 49. I make lists of important terms for teacher training and memorize the lists.                                              | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 50. I attend teacher training regularly.                                                                                      | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 51. Even when teacher training materials are dull and uninteresting, I manage to keep working until I finish.                 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 52. When studying for teacher training I try to determine which concepts I don't understand well.                             | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 53. I often find that I don't spend very much time on teacher training because of other activities.                           | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Part D. Training Effectiveness

The following questions ask about your perception on the training effectiveness about the JICA project teacher training . There are no right or wrong answers, please answer reflecting your experiences. Use the scale below to answer the questions. If you think the statement is very true for you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you. This questionnaire is to receive feedback from you to improve the training activities in the future. Your response will make a difference for the future training. Thank you very much for your cooperation. Tokyo Institute of Technology.

	1	2	3	4	5	6	7				
	Strongly disagree	Mostly disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Mostly agree	Strongly agree				
1. I found the learning experience of teacher training materials to be enjoyable.					1	2	3	4	5	6	7
2. The teacher training materials were just the right length.					1	2	3	4	5	6	7
3. The content of the teacher training material was presented in a way that helped me to learn.					1	2	3	4	5	6	7
4. I expect to refer to one or more of the teacher training materials again.					1	2	3	4	5	6	7
5. I will apply the information that I learned in teacher training materials.					1	2	3	4	5	6	7
6. I intend to apply the skills acquired from the teacher training program.					1	2	3	4	5	6	7
7. I will continue applying the knowledge acquired in teacher training.					1	2	3	4	5	6	7
8. The adoption of teaching methods (student-centered approach, ICT integrated teaching) is within the scope of my abilities.					1	2	3	4	5	6	7
9. I do not anticipate any problems in adjusting to apply teaching method learned (student-centered approach, ICT integrated teaching) in school.					1	2	3	4	5	6	7
10. I feel I am overqualified for teaching using knowledge acquired in training.					1	2	3	4	5	6	7
11. I have the knowledge I need to deal with teaching methods (student-centered approach, ICT integrated teaching), all I need now is practical experience.					1	2	3	4	5	6	7
12. I feel confident that my skills and abilities equal or exceed other teachers.					1	2	3	4	5	6	7
13. My past experiences and accomplishments increase my confidence that I will be able to perform successfully in school.					1	2	3	4	5	6	7

### Appendix 3: Rotated component matrix of exploratory factor analysis – 1

**Rotated Component Matrix<sup>a</sup>**

	Component									
	1	2	3	4	5	6	7	8	9	10
Slfef 3: I expect to do well in this teacher training.	.674	.185	.125	.286	.039	.003	.012	.150	.230	.041
Intr 3: The most satisfying thing for me in teacher training is trying to understand the content as thoroughly as possible..	.666	.301	.153	.226	.238	.121	.009	.020	.034	-.064
Intr 1: In teacher training, I prefer the materials that really challenge me so I can learn new things.	.644	.322	.197	-.001	.164	.041	.050	-.073	-.011	.001
Tskv 4: I think the materials in teacher training are useful for me to learn.	.643	.281	.297	.113	.236	.089	.031	.098	.017	.023
Slfef 5: Considering the difficulty of teacher training and my skills, I think I will do well in this training.	.620	.238	.189	.168	.143	.086	.152	-.061	-.070	.001
Slfef 1: I'm confident I can understand the basic concepts taught in teacher training.	.588	.077	.009	.308	.055	.246	.285	.016	-.030	.271
Tskv 2: It is important for me to learn the materials in teacher training.	.561	.376	.140	-.045	.059	.128	.061	.109	-.072	.280
Intr 2: In teacher training, I prefer the materials that arouses my curiosity, even if it is difficult to learn.	.561	.151	.273	.147	.143	.210	-.026	.221	.331	.169
Slfef 4: I'm certain I can master the skills being taught in this teacher training.	.558	.331	.146	.113	.340	.154	.056	-.036	-.161	.096
Tskv 3: I am very interested in the content area of the teacher training materials.	.546	.219	.181	.301	-.053	.335	-.080	.130	.126	-.021
Satisf 5: I will apply the information that I learned in teacher training materials.	.210	.777	.165	.117	.203	.097	.106	.055	-.046	.126
Intent 1: I intend to apply the skills acquired from the teacher training program.	.295	.734	.264	.069	.137	.012	.182	-.002	-.016	-.049
Intent 2: I will continue applying the knowledge acquired in teacher training.	.269	.720	.237	.125	.175	.007	.131	.113	.018	.103
Satisf 3: The content of the teacher training material was presented in a way that helped me to learn.	.237	.694	.221	.187	.152	.052	.001	.113	.036	-.006
Satisf 2: The teacher training materials were just the right length.	.256	.633	.139	.253	-.060	.121	-.052	.158	.133	-.066
Satisf 1: I found the learning experience of teacher training materials to be enjoyable.	.422	.603	.211	.156	.089	-.014	.054	-.035	.150	-.010
Ptfe 1: The adoption of teaching methods (student-centered approach, ICT integrated teaching) is within the scope of my abilities.	.215	.580	.232	.146	.150	.008	.208	.071	-.043	.180
Ptfe 2: I do not anticipate any problems in adjusting to apply teaching method learned (student-centered approach, ICT integrated teaching) in school.	.065	.552	.249	.218	.077	.114	.112	-.243	-.009	.369
Elab 2: When studying for teacher training, I try to relate the training material to what I already know.	.181	.346	.759	.028	.133	.102	.012	.077	.065	.071
Crit 4: I try to play around with ideas of my own related to what I am learning in teacher training.	.186	.330	.757	.072	.017	.091	.055	.118	.072	.104
Org 4: When I study for teacher training, I go over my notes and make an outline of important concepts.	.224	.285	.723	.127	.102	-.008	.021	.149	.065	-.046
Mcg 6: 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 teacher training.	.248	.265	.650	.217	.189	.102	.055	.073	.054	-.020

Org 3: I make simple charts, diagrams, or tables to help me organize teacher training material.	.000	.133	.631	.222	.305	.218	.037	-.028	-.031	.055
Mcg 4: Before I study new teacher training material thoroughly, I often skim it to see how it is organized.	.164	.066	.626	.312	.152	.147	.181	.148	.109	.082
Elab 1: When I study for this training, I pull together information from different sources, such as teacher training seminars, readings, and discussions.	.283	-.003	.493	.446	-.020	-.051	.348	.012	.014	.135
Elab 3: When I study for this training, I write brief summaries of the main ideas from the teacher training materials.	.367	.319	.462	.086	.067	-.094	.171	.133	-.246	-.113
Crit 5: Whenever I read or hear an assertion or conclusion in the teacher training material, I think about possible alternatives.	.211	.188	.253	.746	.103	.056	.063	.121	.106	.016
Elab 4: I try to understand the teacher training materials by making connections between the teacher training guideline and the concepts from the teacher training VCDs (and interactive material).	.188	.308	.074	.615	.149	.119	-.019	.153	-.161	.238
Mcg 7: When studying for teacher training I try to determine which concepts I don't understand well.	.145	.314	.256	.604	.210	-.007	.052	.251	.161	-.004
Crit 2: When a theory, interpretation, or conclusion is presented in teacher training or in the training materials, I try to decide if there is good supporting evidence.	.252	.044	.349	.557	.260	-.026	.259	.132	-.006	-.132
Slfef 2: I'm confident I can understand the most complex materials presented in teacher training.	.491	.115	.122	.529	-.025	.305	.127	.039	-.111	-.112
Org 1: When I study the materials for teacher training, I outline the material to help me organize my thoughts.	.186	.158	.290	.433	.342	.133	-.031	-.069	.028	.326
Crit 1: I often find myself questioning things I hear or read in teacher training to decide if I find them convincing.	.223	.230	.180	.137	.691	.015	.194	.040	.118	.095
Mcg 3: If teacher training materials are difficult to understand, I change the way I read the material.	.196	.235	.203	.362	.529	.102	.075	.201	.196	.099
Org 2: When I study for teacher training, I go through the training materials and my notes and try to find the most important ideas.	.317	.251	.306	.114	.520	-.183	.171	.085	-.155	.232
Crit 3: I treat the teacher training material as a starting point and try to develop my own ideas about it.	.252	.178	.334	.369	.480	.066	.075	.075	-.069	-.114
Mcg 2: When studying for teacher training, I make up questions to help focus my reading.	.254	.201	.275	.121	.408	.362	-.037	.096	.053	-.184
Extr 1: Getting a good assessment in this training is the most satisfying thing for me right now.	.203	.149	.106	.011	.093	.750	.043	.144	.065	.193
Extr 2: If I can, I want to get better assessment in teacher training than most of the other teachers.	.275	-.030	.171	.113	-.041	.728	.153	.039	-.131	-.037
Ptef 3: I feel I am overqualified for teaching using knowledge acquired in training.	-.138	.061	-.049	.449	.123	.490	.449	-.095	.215	-.066
Ptef 5: I feel confident that my skills and abilities equal or exceed other teachers.	.047	.190	.141	.156	.108	.135	.741	.021	.154	.025
Ptef 7: I could have handled more challenging teaching job than the one I am doing.	.242	.438	.168	-.023	.158	.214	.480	.224	.033	-.135
Ptef 6: My past experiences and accomplishments increase my confidence that I will be able to perform successfully in school.	.397	.411	.132	-.012	.148	.005	.460	.186	.148	.124
Eff 3: Even when teacher training materials are dull and uninteresting, I manage to keep working until I finish.	-.003	.095	.126	.203	.004	.007	.040	.823	.081	.093
Eff 2: I work hard to do well in teacher training even if I don't like what we are doing.	.105	.077	.171	.090	.132	.159	.062	.762	-.068	-.107

Ptef 4: I have the knowledge I need to deal with teaching methods (student-centered approach, ICT integrated teaching), all I need now is practical experience.	.036	-.026	.070	.074	-.006	-.069	.263	.016	.712	.075
Satisf 4: I expect to refer to one or more of the teacher training materials again.	.081	.395	.103	-.080	.287	.179	-.132	-.005	.486	-.257
Tskv 1: I think I will be able to use what I learn in teacher training in teaching activities.	.443	.351	.113	.033	.167	.127	-.028	.019	.135	.536

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 90 iterations.

## Appendix 4: Rotated component matrix of exploratory factor analysis – 2

**Rotated Component Matrix<sup>a</sup>**

	Component							
	1	2	3	4	5	6	7	8
Slfef 3: I expect to do well in this teacher training.	.702	.142	.160	.310	.025	-.067	.135	.192
Intr 3: The most satisfying thing for me in teacher training is trying to understand the content as thoroughly as possible..	.627	.314	.158	.222	.235	.134	.041	.055
Slfef 1: I'm confident I can understand the basic concepts taught in teacher training.	.626	.097	.004	.346	.131	.248	.000	-.116
Tskv 4: I think the materials in teacher training are useful for me to learn.	.619	.309	.294	.091	.268	.111	.150	-.004
Tskv 3: I am very interested in the content area of the teacher training materials.	.615	.101	.221	.312	-.103	.215	.106	.267
Intr 2: In teacher training, I prefer the materials that arouses my curiosity, even if it is difficult to learn.	.610	.073	.295	.201	.123	.131	.176	.343
Intr 1: In teacher training, I prefer the materials that really challenge me so I can learn new things.	.607	.368	.207	-.011	.198	.076	-.046	-.058
Slfef 5: Considering the difficulty of teacher training and my skills, I think I will do well in this training.	.569	.274	.193	.199	.182	.136	-.058	-.098
Tskv 2: It is important for me to learn the materials in teacher training.	.563	.433	.126	-.012	.108	.155	.065	-.040
Slfef 4: I'm certain I can master the skills being taught in this teacher training.	.529	.362	.134	.107	.374	.190	-.017	-.068
Tskv 1: I think I will be able to use what I learn in teacher training in teaching activities.	.498	.371	.075	.077	.225	.111	-.037	.144
Satisf 5: I will apply the information that I learned in teacher training materials.	.196	.784	.169	.161	.212	.109	.039	.095
Intent 1: I intend to apply the skills acquired from the teacher training program.	.268	.738	.302	.103	.149	.020	.006	.036
Satisf 3: The content of the teacher training material was presented in a way that helped me to learn.	.173	.735	.206	.200	.154	.101	.145	.098
Intent 2: I will continue applying the knowledge acquired in teacher training.	.254	.727	.251	.163	.197	.021	.109	.065
Satisf 1: I found the learning experience of teacher training materials to be enjoyable.	.396	.622	.234	.158	.102	-.008	-.004	.085
Satisf 2: The teacher training materials were just the right length.	.230	.594	.163	.298	-.118	.098	.134	.276
Crit 4: I try to play around with ideas of my own related to what I am learning in teacher training.	.214	.261	.771	.125	.042	.067	.094	.130
Elab 2: When studying for teacher training, I try to relate the training material to what I already know.	.186	.308	.770	.072	.141	.079	.047	.145
Org 4: When I study for teacher training, I go over my notes and make an outline of important concepts.	.219	.237	.750	.162	.097	-.041	.134	.125
Mcg 6: 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 teacher training.	.224	.264	.645	.234	.208	.106	.097	.055
Mcg 4: Before I study new teacher training material thoroughly, I often skim it to see how it is organized.	.147	.063	.600	.367	.198	.189	.147	.037
Org 3: I make simple charts, diagrams, or tables to help me organize teacher training material.	-.041	.130	.594	.245	.338	.278	-.027	-.008
Elab 3: When I study for this training, I write brief summaries of the main ideas from the teacher training materials.	.293	.355	.465	.098	.132	.006	.164	-.263

Crit 5: Whenever I read or hear an assertion or conclusion in the teacher training material, I think about possible alternatives.	.201	.153	.238	.787	.094	.050	.096	.080
Elab 4: I try to understand the teacher training materials by making connections between the teacher training guideline and the concepts from the teacher training VCDs (and interactive material).	.168	.328	.022	.650	.157	.159	.094	-.032
Mcg 7: When studying for teacher training I try to determine which concepts I don't understand well.	.157	.254	.264	.634	.178	-.054	.240	.193
Crit 2: When a theory, interpretation, or conclusion is presented in teacher training or in the training materials, I try to decide if there is good supporting evidence.	.221	.047	.352	.564	.291	.001	.176	-.119
Slfef 2: I'm confident I can understand the most complex materials presented in teacher training.	.478	.105	.119	.506	-.003	.322	.094	-.127
Elab 1: When I study for this training, I pull together information from different sources, such as teacher training seminars, readings, and discussions.	.224	.087	.458	.495	.099	.077	.020	-.295
Org 1: When I study the materials for teacher training, I outline the material to help me organize my thoughts.	.196	.137	.241	.469	.375	.152	-.113	.087
Crit 1: I often find myself questioning things I hear or read in teacher training to decide if I find them convincing.	.225	.197	.179	.196	.687	-.002	.036	.216
Org 2: When I study for teacher training, I go through the training materials and my notes and try to find the most important ideas.	.288	.310	.280	.151	.590	-.123	.056	-.146
Mcg 3: If teacher training materials are difficult to understand, I change the way I read the material.	.221	.178	.198	.415	.496	.043	.176	.299
Crit 3: I treat the teacher training material as a starting point and try to develop my own ideas about it.	.188	.197	.299	.354	.496	.126	.144	-.027
Mcg 2: When studying for teacher training, I make up questions to help focus my reading.	.224	.151	.264	.094	.379	.372	.175	.185
Extr 2: If I can, I want to get better assessment in teacher training than most of the other teachers.	.223	.027	.143	.143	-.031	.805	.029	-.097
Extr 1: Getting a good assessment in this training is the most satisfying thing for me right now.	.231	.144	.073	.056	.074	.733	.122	.221
Eff 2: I work hard to do well in teacher training even if I don't like what we are doing.	.091	.083	.154	.063	.134	.184	.826	-.039
Eff 3: Even when teacher training materials are dull and uninteresting, I manage to keep working until I finish.	.022	.098	.113	.217	-.003	-.010	.808	.050
Satisf 4: I expect to refer to one or more of the teacher training materials again.	.072	.280	.148	-.019	.157	.082	-.013	.659

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

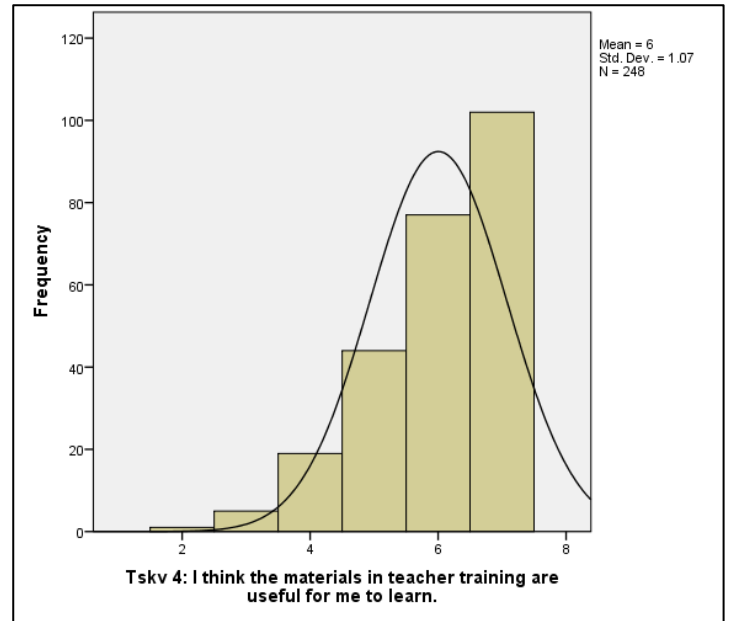
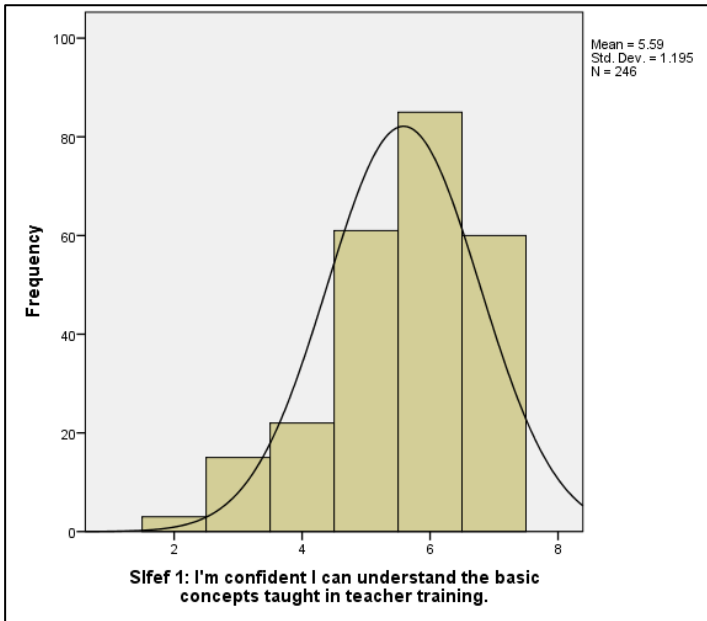
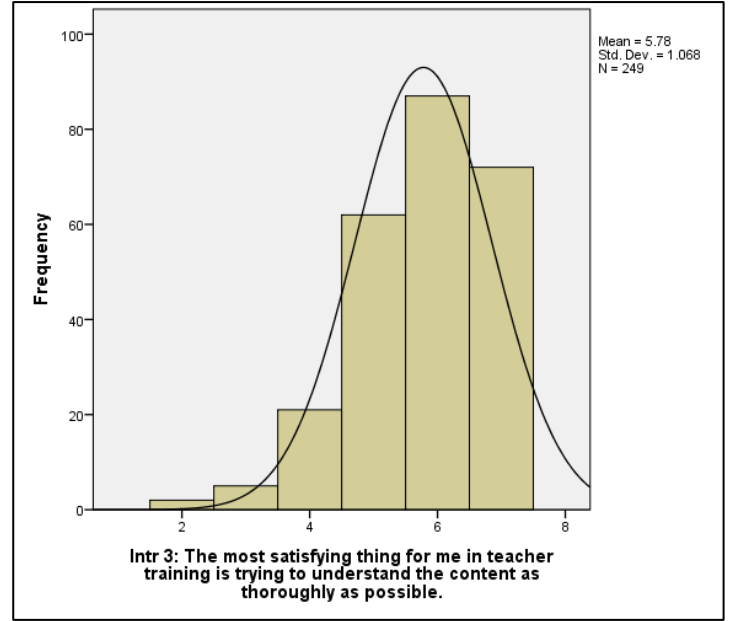
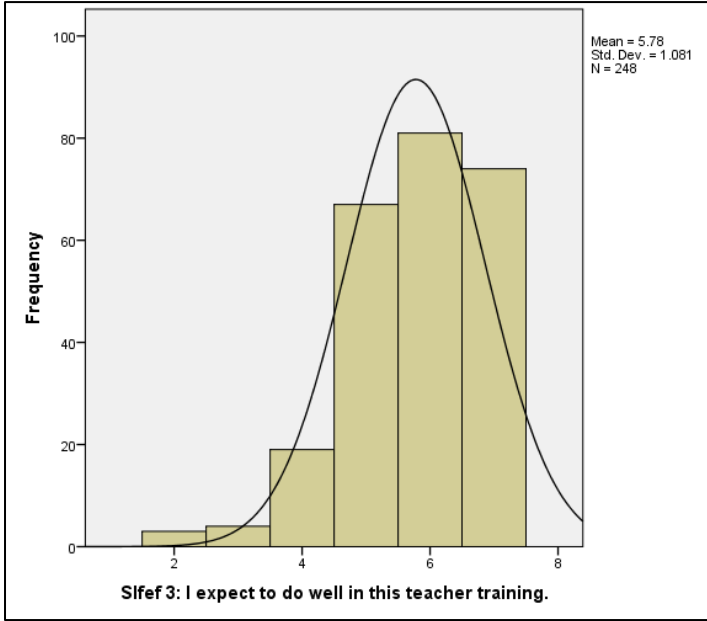
a. Rotation converged in 13 iterations.

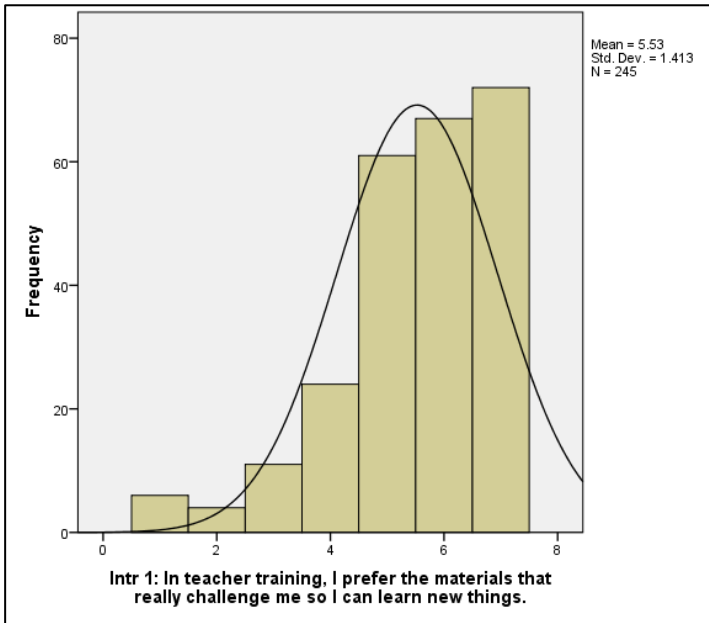
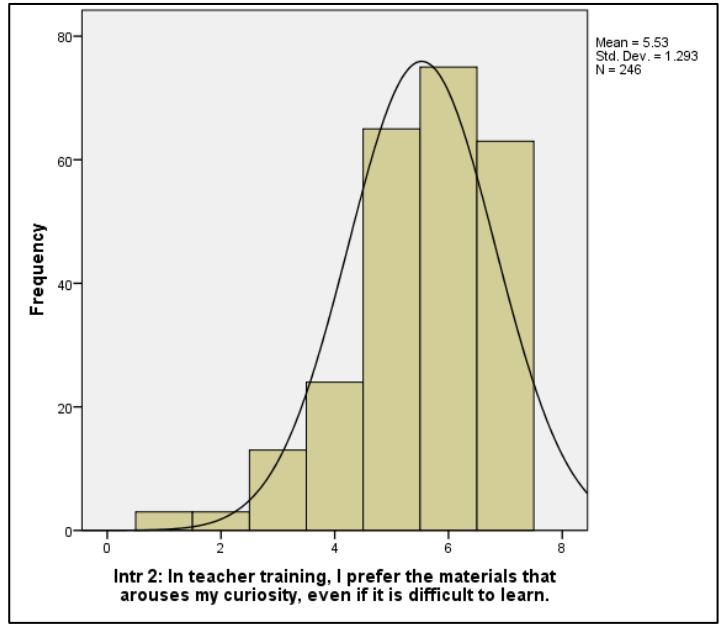
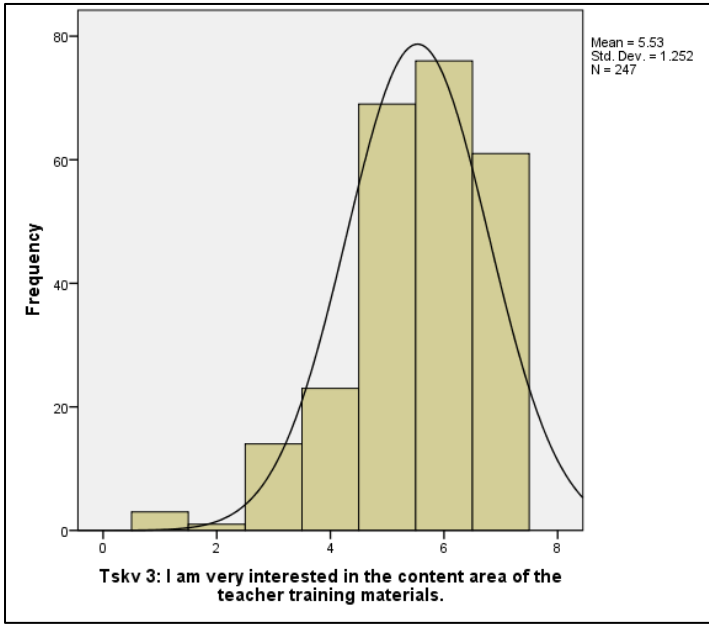
## Appendix 5: Descriptive statistics and histograms of the constructing items for latent variables

### 1) Internal motivation

**Table 13-1: Descriptive statistics of the constructing items for internal motivation**

	N		Mean	Median	SD	Variance	Min	Max
	Valid	Missing						
Slfef 3: I expect to do well in this teacher training.	248	1	5.78	6	1.08	1.16	2	7
Intr 3: The most satisfying thing for me in teacher training is trying to understand the content as thoroughly as possible.	249	0	5.78	6	1.06	1.14	2	7
Slfef 1: I'm confident I can understand the basic concepts taught in teacher training.	246	3	5.59	6	1.19	1.42	2	7
Tskv 4: I think the materials in teacher training are useful for me to learn.	248	1	6.00	6	1.07	1.14	2	7
Tskv 3: I am very interested in the content area of the teacher training materials.	247	2	5.53	6	1.25	1.56	1	7
Intr 2: In teacher training, I prefer the materials that arouses my curiosity, even if it is difficult to learn.	246	3	5.53	6	1.29	1.67	1	7
Intr 1: In teacher training, I prefer the materials that really challenge me so I can learn new things.	245	4	5.53	6	1.41	1.99	1	7

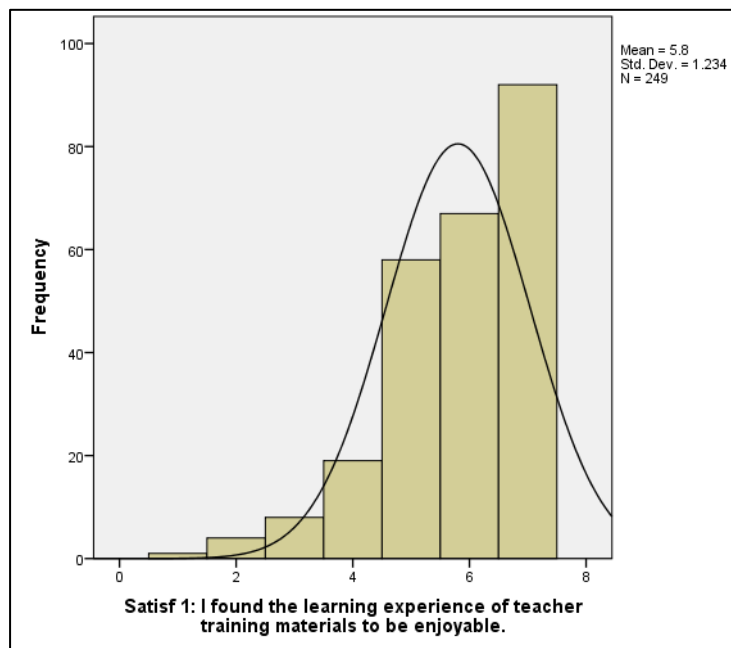
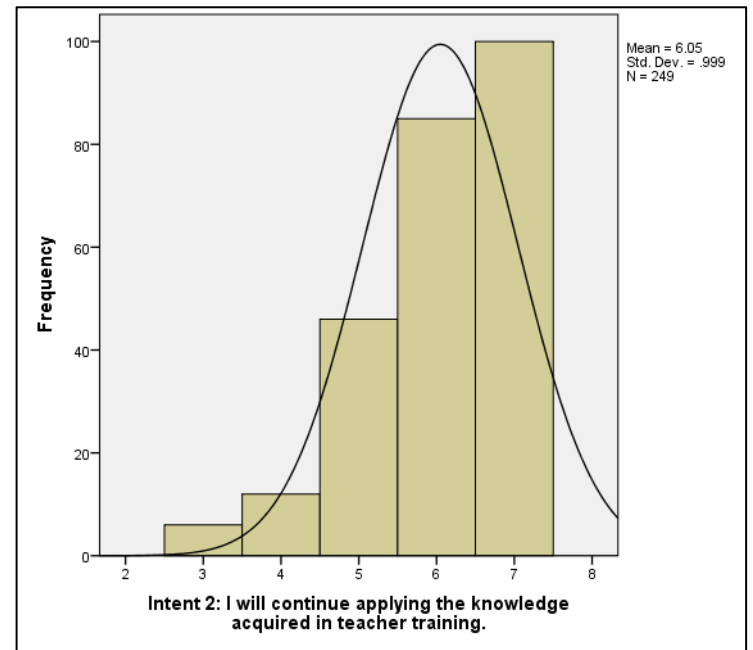
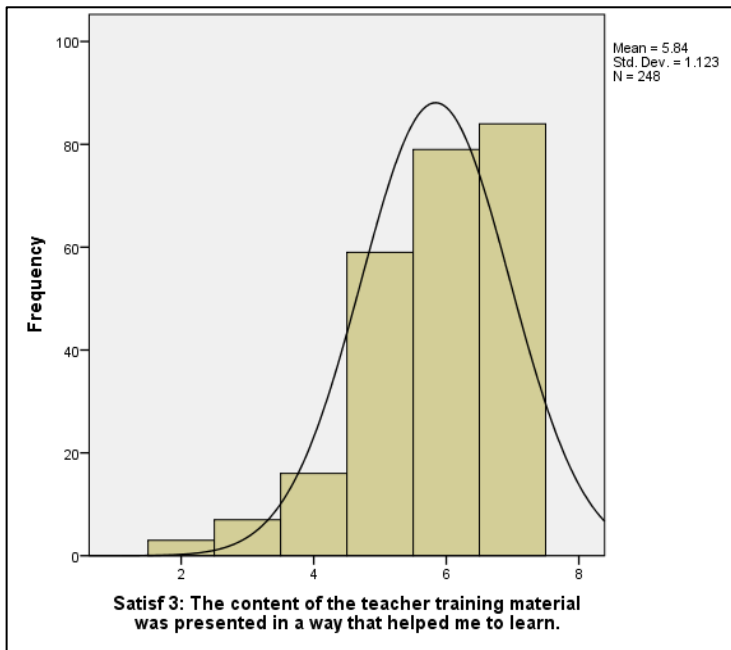
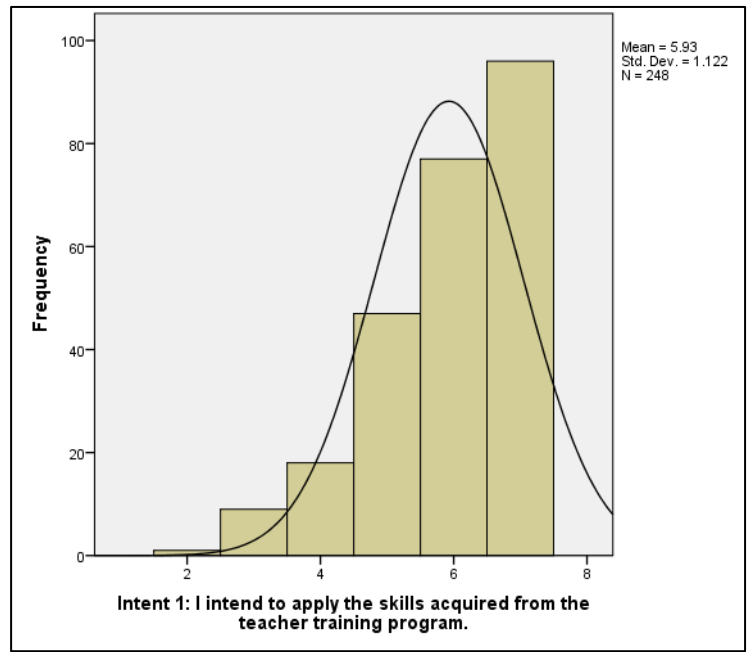
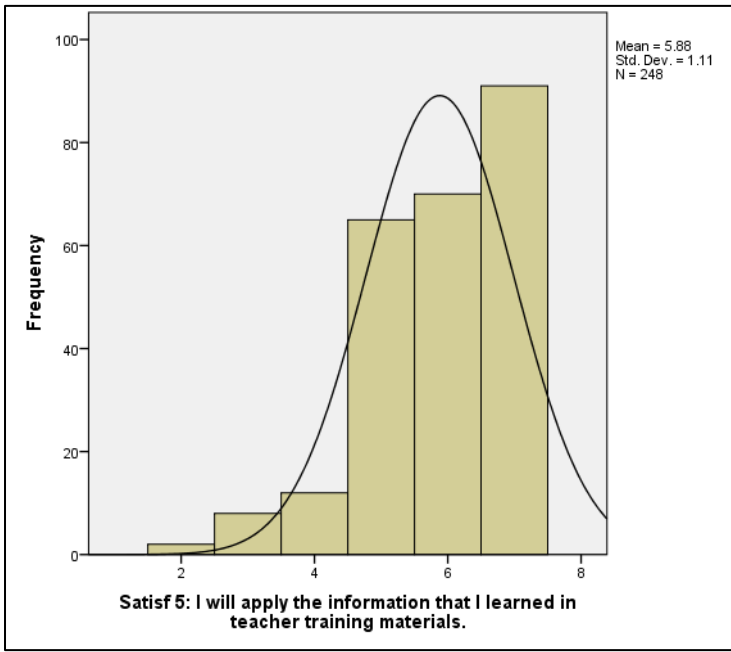




2) Learning satisfaction and intention to apply learning contents

**Table 13-2: Descriptive statistics of the constructing items for learning satisfaction and intention to apply learning contents**

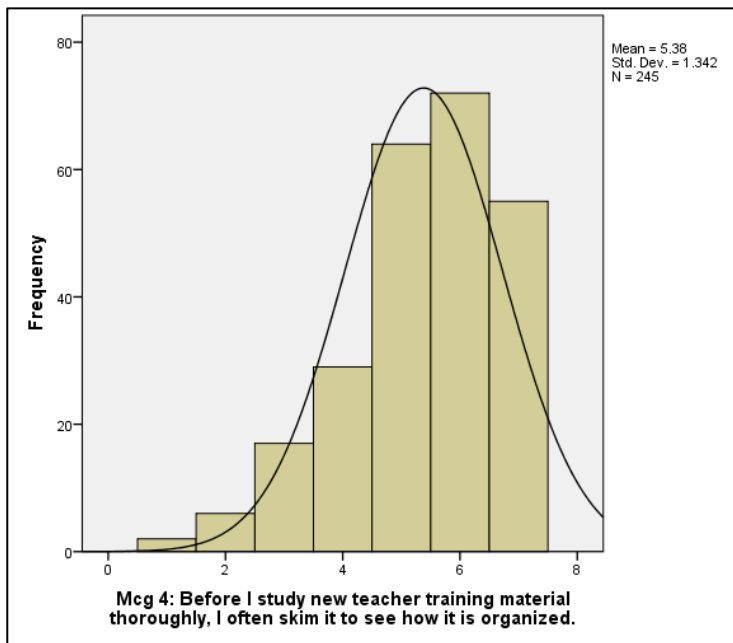
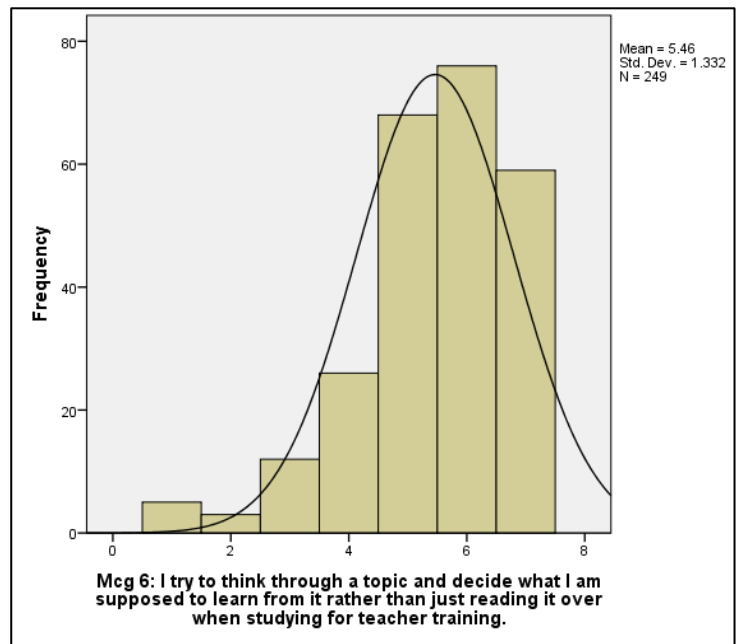
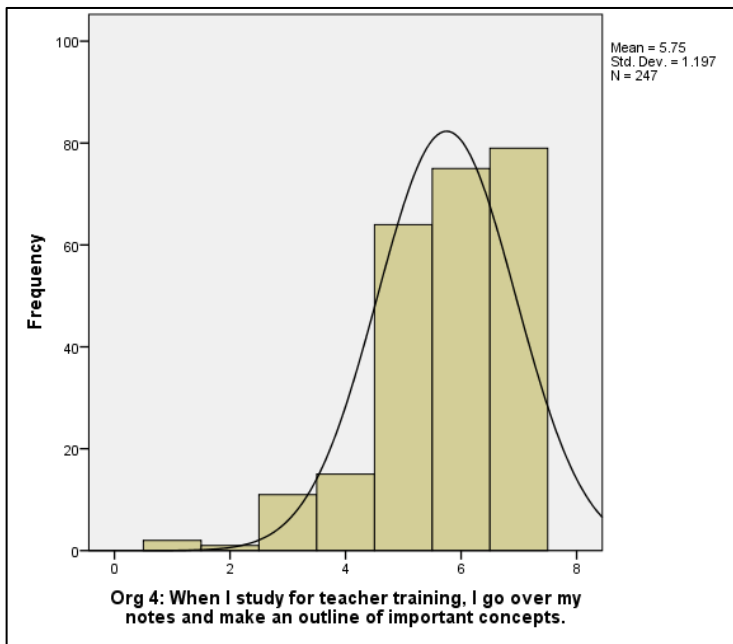
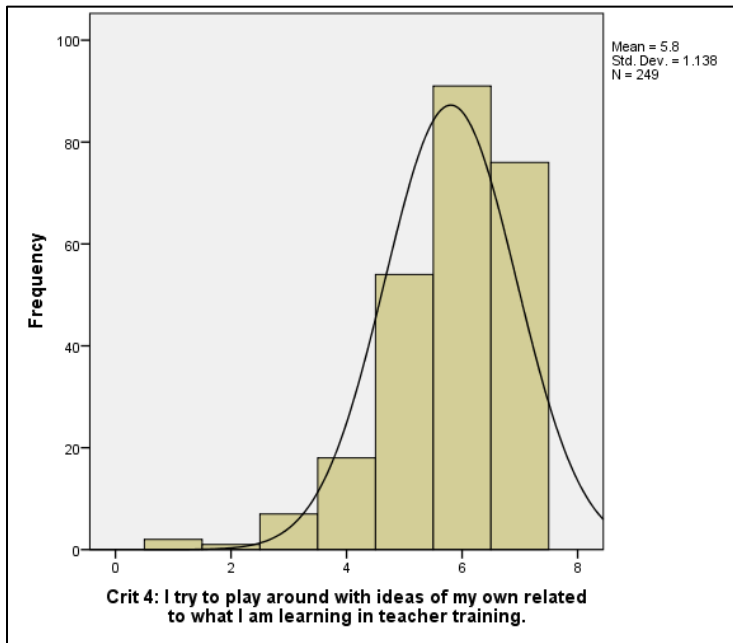
	N		Mean	Median	SD	Variance	Min	Max
	Valid	Missing						
Satisf 5: I will apply the information that I learned in teacher training materials.	248	1	5.88	6	1.11	1.23	2	7
Intent 1: I intend to apply the skills acquired from the teacher training program.	248	1	5.93	6	1.12	1.25	2	7
Satisf 3: The content of the teacher training material was presented in a way that helped me to learn.	248	1	5.84	6	1.12	1.26	2	7
Intent 2: I will continue applying the knowledge acquired in teacher training.	249	0	6.05	6	1.00	1.00	3	7
Satisf 1: I found the learning experience of teacher training materials to be enjoyable.	249	0	5.80	6	1.23	1.52	1	7



3) Planning and organizing skills

**Table 13-3: Descriptive statistics of the constructing items for planning and organizing skills**

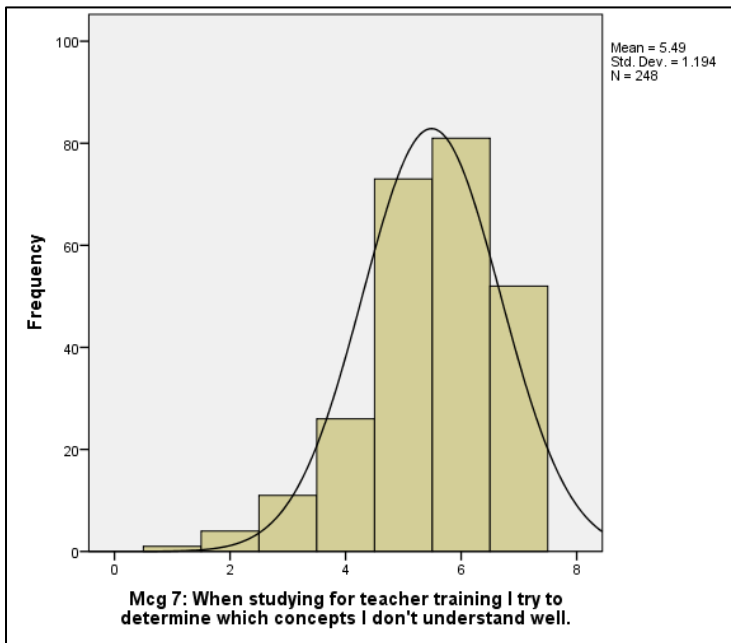
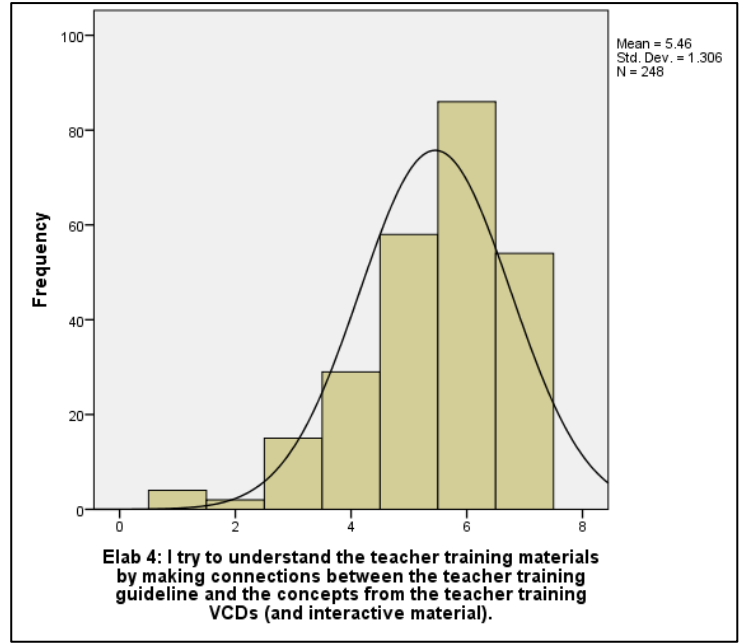
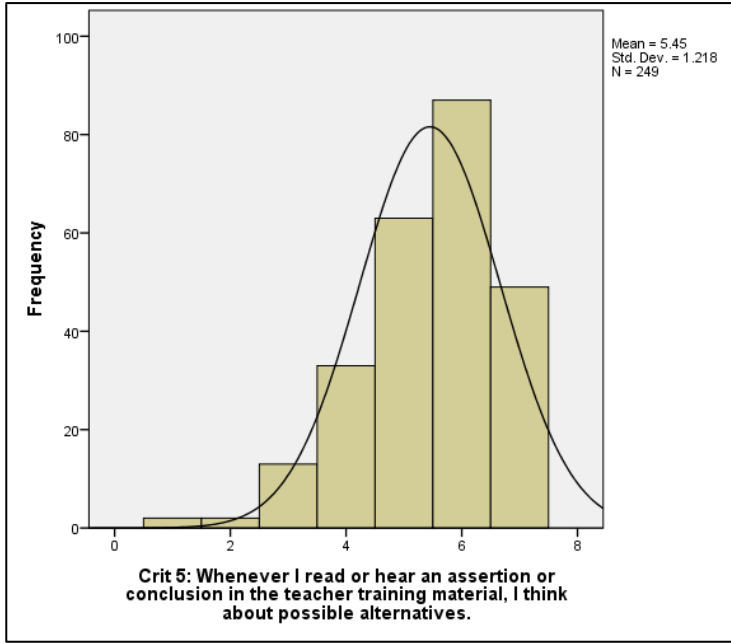
	N		Mean	Median	SD	Variance	Min	Max
	Valid	Missing						
Crit 4: I try to play around with ideas of my own related to what I am learning in teacher training.	249	0	5.80	6	1.14	1.30	1	7
Elab 2: When studying for teacher training, I try to relate the training material to what I already know.	248	1	5.81	6	1.21	1.47	1	7
Org 4: When I study for teacher training, I go over my notes and make an outline of important concepts.	247	2	5.75	6	1.20	1.43	1	7
Mcg 6: 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 teacher training.	249	0	5.46	6	1.33	1.77	1	7
Mcg 4: Before I study new teacher training material thoroughly, I often skim it to see how it is organized.	245	4	5.38	6	1.34	1.80	1	7



4) Critical and positive thinking skills

**Table 13-4: Descriptive statistics of the constructing items for critical and positive thinking skills**

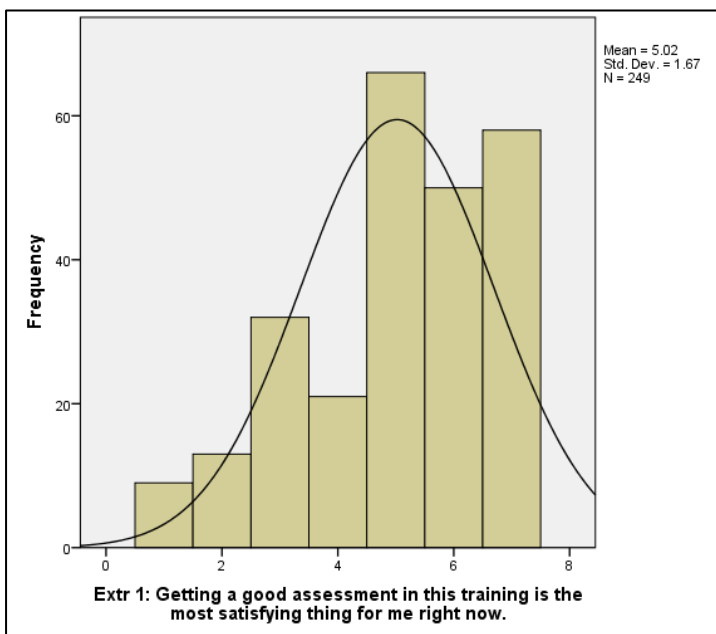
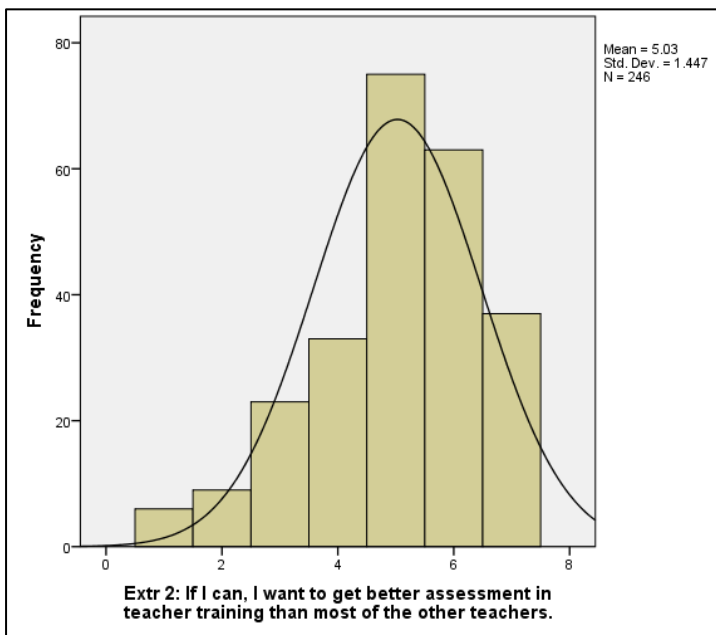
	N		Mean	Median	SD	Variance	Min	Max
	Valid	Missing						
Crit 5: Whenever I read or hear an assertion or conclusion in the teacher training material, I think about possible alternatives.	249	0	5.45	6	1.22	1.48	1	7
Elab 4: I try to understand the teacher training materials by making connections between the teacher training guideline and the concepts from the teacher training VCDs (and interactive material).	248	1	5.46	6	1.31	1.71	1	7
Mcg 7: When studying for teacher training I try to determine which concepts I don't understand well.	248	1	5.49	6	1.19	1.43	1	7



5) Motivation for better assessment

**Table 13-5: Descriptive statistics of the constructing items for motivation for better assessment**

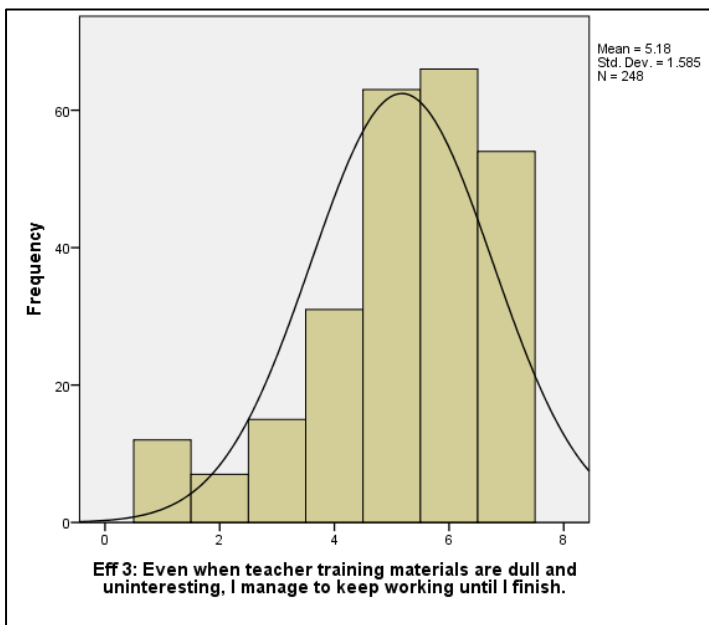
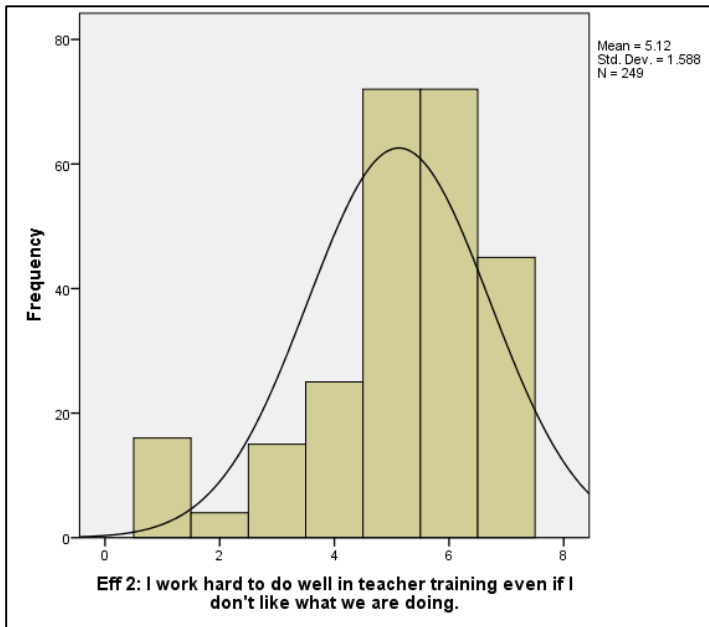
	N		Mean	Median	SD	Variance	Min	Max
	Valid	Missing						
Extr 2: If I can, I want to get better assessment in teacher training than most of the other teachers.	246	3	5.03	5	1.45	2.09	1	7
Extr 1: Getting a good assessment in this training is the most satisfying thing for me right now.	249	0	5.02	5	1.67	2.79	1	7



6) Effort regulation

**Table 13-6: Descriptive statistics of the constructing items for effort regulation**

	N		Mean	Median	SD	Variance	Min	Max
	Valid	Missing						
Eff 2: I work hard to do well in teacher training even if I don't like what we are doing.	249	0	5.12	5	1.59	2.52	1	7
Eff 3: Even when teacher training materials are dull and uninteresting, I manage to keep working until I finish.	248	1	5.18	5	1.59	2.51	1	7



## Appendix 6: Qualitative data collected from focus group discussion and interviews with local primary school teachers in Bayankhongor

Background information of focus group discussion and interview:

- 1) Erdem School, 10:00 – 12:00, 22 September, 2017
- 2) Sogoseikyo School, 12:40 – 13:30, 22 September, 2017
- 3) Nomgon School, 16:00 – 18:00, 22 September, 2017
- 4) During teacher training using interactive materials, 13:30 – 15:00, 24 September, 2017
- 5) Dolgor-bagsh (local Education Culture Department methodologist), 26 September, 9:00

The following are the questions asked and the responses from the teachers. Each question has five sub-sections corresponding with feedback received from the five groups of teachers mentioned in the background information. Please note that there are cases where the author probes the response from teachers with questions in the process of discussion.

### In relation to research question 1

- 1 What are the factors affecting learning satisfaction and intention to apply learning contents among these 5 factors, in your experience?
  - 1.1 Critical and positive thinking, planning and organizing skills, and effort regulation. The planning processes, if you plan well the outcome will be very positive.
  - 1.2 Critical and positive thinking skills, planning and organizing skills.  
Confirming the things that we don't know, as a teacher connecting previous knowledge with current new knowledge is an obvious thing to do. If you receive knowledge positively, it will affect the critical and positive thinking skills.
  - 1.3 A: Critical and positive thinking, planning and organizing skills, internal motivation.  
B: All of them.
  - 1.4 Critical and positive thinking, planning and organizing skills, motivation for better assessment.

- 1.5 Internal motivation, critical and positive thinking, and planning and organizing skills are the most important factors.
- 2 Do you agree that internal motivation, critical and positive thinking skills, planning and organizing skills are important factors affecting learning satisfaction and intention to apply learning contents? How about the other two?
- 2.1 Yes agree. It is important to plan also important to think positively.

Internal motivation: It's important that the materials have to be interesting, if the materials are very boring teachers will lose motivation to learn, if they are more positive to learn they are going to spread out the words to let other teachers to use.

Critical and positive thinking skills: It links with the internal motivation, if the material has good contents then teachers can also be very creative in teaching from that material, and think critically.

Very much, it is going to affect learning satisfaction negatively if they don't apply critical and positive thinking skills. It will affect positively they can learn more, if they don't know the answer they will try to think differently. Therefore, to learn new things you need to have critical and positive thinking. It's important to look at everything positively, even if it is difficult and it will become easy. If you thinking positively you can overcome difficulties it will also help in building relationships with other teachers.

Planning and organizing skills, if the planning is well the organization will also be well. If you have planning skills it will affect your critical and positive thinking, it is always related to each other. If you have good planning, learning contents will be organized well. It will result in positive outcomes. If you also plan out well, you can gather a lot of information. Through planning, teachers will try to make sure they apply the skills they are good at well. And using the skills well will make sure better learning outcomes.

As a team, we plan together. As a team, we gather many ideas and implement them in classes. As a team, you can plan well, you are more critical and have more positive thinking with that you can plan well.

- 2.2 Agree. When we are internally motivated, we prepare well for lesson, we deliver that contents well (intention to apply learning contents). Afterwards, the outcomes are also good. In order to develop learning contents, if we have good motivation we can use other skills to create better lessons.

So, internal motivation is more important?

If we learn teacher training materials while internally motivated, we can prepare well and understand well because we want to do ourselves and the outcomes are very positive.

- 2.3 Internal motivation affects learning satisfaction because teachers feel more satisfied if they understand the value of learning contents.

When you are interested in material, you end up being critical and positive. Connecting prior knowledge with new knowledge is important. (connecting prior knowledge is a skill included in both critical and positive thinking skills and planning and organizing skills)

Being critical and positive will bring your better satisfaction?

Through critical thinking using the current knowledge, teachers think about how to make the learning more effective, with critical thinking you can also learn new knowledge from other places or people.

Planning and organizing skills. Lessons are connected together, when you have hardships in the previous class, you would need to find information to make lesson better the next time, thus planning skills are important.

When teaching, the teaching contents can be abstract, we try to make it realistic to students, using videos of pictures to make it more realistic to students.

Critical thinking skills: we cannot say the answer we find is the only answer, we have to find other answers, we also need to understand why it is like that.

Talking about students. When students are having problems, they use their critical thinking skills to get away from that problem (to find a solution by asking why).

Planning and organizing skills. It's important to plan, when we plan well we need to organize well, if we plan (our teaching contents) well the students can understand well.

How about the use of planning and organizing skills for learning teacher training materials yourselves?

When attending teacher training lectures, we plan in mind how to take notes so that we understand how to take notes, when we read back later it must be readable and understandable for us in the future. We need a plan for self-development to reach a good learning satisfaction.

Two factors not affecting. Teachers do not agree, when there is an effort made by teachers our learning satisfaction will change. When we are learning, we should put effort.

If you want to do better in assessment, it will have positive reinforcement on us.

Discussing five SRL processes as a whole, teachers believe the three are more important than the other two.

- 2.4 We agree.

If you agree, could you describe how your internal motivation can affect your satisfaction?

The feeling of the need to learn affect satisfaction, because we know the purpose, will result in internal motivation for higher satisfaction.

When you are attending the training, we need to have a positive mindset, that results for a better outcome for that person.

If you think critically in learning, do you think it increases your learning satisfaction?

When you are critical in certain thing, that knowledge stays in you, that's why we need to be critical in learning. When thinking critically, we do more research, the outcome is better, it increases the learning satisfaction.

How about planning and organizing skills in learning? Do you feel if you plan well you have better satisfaction? Can you share experience on that?

Yes we do feel so. We you plan well, we are not overloaded, we have less work to do, that results in better outcome. When we plan, it saves a lot of time, that has a better outcome.

How about the motivation for better assessment that you think is affecting?

You want to do better, you are encouraged to do better, that will result in learning satisfaction. Also, it motivates you to learn better from there on. When you plan things well, then you assess based on that, when you have good assessment, you want to do better next time.

We want to make interactive materials to assess ourselves.

- 2.5 First of all, because I have the need to understand the learning material, that is related to the internal motivation. Without knowing why it is necessary for you, that person cannot use it to its full potential. You have to know it is necessary from the bottom of your heart. (Unless value of learning material is clear, there will be no effective learning outcome.)

When you read the training material, you end up thinking will it be helpful to improve my theoretical knowledge or it will helpful to improve my teaching methodology, or everyday life. You use critical and positive thinking skills to determine which material is useful for you in what aspect, which results in better satisfaction. Critical and positive thinking are trying to find out things are useful for myself.

When you read the material, you know which aspect it belongs to, for example teaching methodology, or the other 2 aspects. Now you need to search for more material, read more, search more on Internet, you then need a precise plan on that which influences the learning satisfaction. Personally, when I do certain things I plan out well, no matter reading or writing something, in my opinion, planning and organizing skills are leading other

skills. It affects satisfaction very much, because she increases knowledge after planning well, and she can tell other teachers what she has learned.

Assessment is not as important as the other three, assessment comes later on, therefore it is not as important as the other three in terms of influencing learning satisfaction.

Effort regulation seems like in the internal motivation, planning and organizing, critically thinking. Effort just comes out as part of the use of these three skills.

Most of the times, if you think thoroughly and plan thoroughly it does go according to plan, sometimes due to outside influence it can change the plan. Depending on students it can change the plan.

\*\* I explained the meaning of effort regulation: the ability to learn even when you feel contents are not interesting.

For effort regulation, if you feel if you have to know, have to do, then it affects your learning satisfaction, considering you give efforts. If you don't make that efforts then it will affect satisfaction negatively.

\*\*You agree that Bayankhongor teachers are making effort even when they are not interested, so this factor is not that relevant?

Associate with the work you do, regarding effort regulation, if there are something you really need to know, really interested, then you make more effort in it. If you don't see the impact on that thing, you give less effort, for certain people, they give less effort or more effort.

\*\* So internal motivation is more important?

Before I said planning and organizing skills leads the other skills, I change the mind that internal motivation comes number one, then planning and organizing skills, then critical and positive thinking.

#### In relation to research question 2

- 3 Is your motivation for better assessment higher with interactive materials? If so, what are the reasons? (slide 6)
  - 3.1 Yes, we feel higher motivation for better assessment. It affects other three skills, planning and critical thinning, it also motivates the students, we have implemented the classroom.

Talking about use of interactive material in classroom: teachers have observed a higher motivation for better assessments, they are more active in class. Instead of just writing on board, using this interactive material is more attractive (internal motivation).

It's interesting for us so in order to get correct answer we need to do research to gather information. We use ICT and gather information through ICT. We want to learn how to make this program for ourselves, we also want to make a student version for use by students.

3.2 By reading a lot of things, the result is more positive. The reason is in order to find correct answer, we have to look through many answers and find the correct answer.

3.3 Yes, we do feel that. For example, for first grade there are pictures we need to find differences that helps us to have higher motivation for better assessment.

Do you think the quiz function has an influence? How does it influence?

Yes, it does. Students / teachers can know right away the right or wrong answer, they can correct the mistake right at that spot. After using interactive materials, students/teachers are creating their own questions to discuss with other students/teachers. When doing interactive material, they/we do more research and students/we are more curious. \*At this point we asked the question whether the discussion applies to both student and teachers in learning, and teachers confirmed that the observation applied to both students and teachers. As students go to higher level, students become more curious.

3.4 Why do you feel higher motivation for better assessment? Because you know the result right away. Because there is summary at bottom you understand wrong ones immediately.

We agree that satisfaction is better, it become interested we want to go further to develop ourselves because it prompts us to do so.

We want to apply more learning contents.

Is it because you feel more confident and comfortable in applying these contents?

Yes, we will use it for that purpose. Because it talks about subjects that are hard to teach, it makes it easier for them in understanding learning contents. It has repetition, it helps us to memorize them. You are refreshing by contents when you do these interactive material, you drag to the box, you are not just thinking abstractedly, you fill in blanks carefully.

3.5 They are especially increasing in motivation for better assessment. Interactive materials to self-assessment, check in my understanding if it is right or wrong.

4 Regardless of using interactive materials, do you think you have similar level of internal motivation, use of planning skills, use of critical and positive thinking skills and effort regulation? If yes, what are the reasons? (slide 6)

4.1 We have it regardless of using interactive materials.

4.2 Interactive materials have positive effects to students.

4.3 Depending on material content, they can all be equal.

It varies from people to people.

4.4 Yes, we have similar level. Interactive materials save time to get feedback of results. Do you have same level of internal motivation, planning and organizing skills, critical thinking skills and effort regulation in doing any teacher training materials?

When you are reading and writing, you end up with same level of internal motivation and critical thinking skills because you highlight and read afterwards that's why it is the same level.

Attitudes towards it will be the same, but outcomes may be different.

Attitudes will not change, if you need, we will take in that information regardless of materials, for interactive materials, you just have feedback immediately, that's the only different, for other factors we will apply the same amount.

The reason why we request to make because it is for students, because they can assess themselves immediately in class.

4.5 These four processes are more or less the same with or without the interactive materials. Regardless of anything they do, they first have to have internal motivation to do, then they plan how can they learn, then they will think critically on how they can use it. That's why it is same amount regardless of interactive materials.

5 Is your learning satisfaction and intention to apply learning contents higher with interactive materials? If so, could you describe why you feel more satisfied?

5.1 It (learning satisfaction) increases because she can use it for her students and it saves time, she is more confident in delivering the contents, because she knows what she is doing (learning satisfaction and intention to apply learning contents).

Is this because these materials give you more confidence since you could understand better?

Yes, because I get more information from interactive materials I can get more information.

Showing one thing is one thing, making person do is different, doing then knowing what is right and wrong is different from knowing what is right and wrong. It influences other teachers, other teacher looking at it and other teachers are interested.

5.2 Yes, we have higher learning satisfaction. In order to come up with one solution, we have to use many other skills.

- 5.3 Yes. Because we have to try applying the learning contents when learning with interactive materials, if we use it 100% (to its full potential) the satisfaction is higher (than without interactive materials).

So interactive materials can help you better apply the training contents?

Yes.

How is it easier compared with not using it?

- 5.4 If we don't have interactive materials, we get lost and don't know what we are supposed to do. Interactive materials help teachers to learn what they do not know, helps teachers to save time, teachers are very satisfied because of many advantages.
- 5.5 She thinks it is slightly higher. When you use interactive material, you realize whether you know certain things right or not, when you assess, you notice you can learn certain things thoroughly, that is how it is influencing satisfaction.

#### In relation to research question 3

- 6 If using interactive materials, when you feel more internally motivated, your learning satisfaction will be higher than teachers who do not use interactive materials, do you feel so?

Do you think your curiosity or pleasure of learning is fostered in using interactive materials that in turn affects learning satisfaction? (slide 8)

- 6.1 Yes, we agree. We can receive pleasure from interactive materials. Teachers are motivated to do better and they become more critical, they research many things they gather many information.

When using interactive material, we realize the value of contents and we want to learn the next time.

Does it mean the value is not so clear when you don't use it?

It is kind of vague because the information from internet and other sources make it difficult to grasp the value.

- 6.2 Yes agree. Even if you are students, your internal motivation affects your learning. Agree, when you give a test to someone without internal motivation then they will not perform better. If they know what they are supposed to do, they will perform better. We have to love interactive materials in order to work with it (to get better learning outcomes).
- 6.3 Yes, we agree. Because we cannot constantly rely on interactive materials, we notice the need to refer to other resources, we feel motivated to refer to other resources. From the previous training, the programs we received, the contents were very limited, we want to make our own.

- 6.4 Internal motivation. We agree because when you use interactive materials, the outcome will be different. Because outcome is fast, your satisfaction is higher. Because we can have higher satisfaction. We have really high satisfaction that's why we want you to teach us doing that.

Because it gives us answers right and wrong, you think thoroughly all the answers given.

- 6.5 I agree. Quality of influence because teachers use interactive materials can assess themselves, but teachers who do not use it cannot assess themselves.

\*\* With the same level of interest, since interactive materials provide learner with ability to assess, it will fulfill that internal motivation to result in higher satisfaction.

Teachers who do not use it just read and then they cannot assess themselves, but teachers who use interactive materials can assess themselves in detail.

\*\* So, this function really affects the quality of the relationship?

Yes.

\*\* Other functions that facilitate the quality of curiosity in learning? That resolve your curiosity or perceived value to better satisfaction?

Other than assessing, you know the correct answer. First, you get to compare, second, you drag answers to blanks that creates logic, you get to understand in which order it is going to be correct. Multiple choice, you get to separate what is correct and what is wrong, that caters the curiosity for them to learn better.

\*\* So, I can say these caters curiosity (internal motivation) to learn better?

Yes. You get to learn how to compare, you get to identify the logic, order of sequences really well.

Because they can identify logic, sequence, that affects their learning satisfaction.

- 7 Do you agree that before you use interactive materials, having a higher motivation for better assessment will make you feel less satisfied in learning teacher training materials? Please share your thoughts.

Do you agree that after you use interactive materials, feeling higher motivation for better assessment will make you feel more satisfied in learning? If so, what features in interactive materials do you think are related? (slide 9)

- 7.1 Yes, we do have more stress if we do not use interactive materials, we doubt the information from Internet whether it is right or wrong but if we use interactive materials we become more confident.

Teachers agree. Interactive materials are useful, with it we can see it has a better outcome. When teachers don't know certain things, they tend to leave it and they do not deal with that. With interactive materials, they try to deal with it since they can experiment with the answers to see which one is correct.

When you cannot experiment, having higher motivation for better assessment, will result in slightly less outcome? Yes it affects, it affects their motivation and they don't want to do what they are doing, it makes them notice what they do is incomplete and the outcome has bad quality. They tend to postpone, do the research later without interactive materials, using interactive materials we can experiment with different ideas. We have to find the correct one, the experimental feature is making us find the correct one.

- 7.2 Yes, we agree. The reasons for teachers using interactive having satisfaction they can learn well so the knowledge can stay within them, so that explains why satisfaction is high. They do self-assessment and understand where they have problems with which gives them better learning outcomes.

When you are without interactive materials, you may feel unsatisfied with yourself since you don't know some stuff, with interactive materials we know where we are which helps us plan how to perform better. When you know where you are in learning, it helps you identify how you can be better later on, helps you to plan. When using, you identify your mistakes, you then know what to learn next time. With interactive material, there is no other (third) person involved in assessment, you and your program with interactive materials, we feel comfortable.

- 7.3 We agree. Because through interactive materials we discover what we do not know when we are assessing ourselves, that will make us feel satisfied with learning.

We cannot learn what we wanted to learn if we do not use interactive materials so that will result in less learning satisfaction. Those who use interactive, they assess them but for teachers who do not use they do not assess that could influence their satisfaction.

You don't know how much you know if you don't have access to interactive materials, we do not know how many percent we know.

- 7.4 Motivation for better assessment. Yes, we agree with that. Because the outcome is fast.

Say when the outcomes are not fast, does it make you stressed or less confident that decreases satisfaction.

Yes, it affects us because they don't know whether they get it right or wrong.

- 7.5 I agree. Because when you use it, you can assess the quality of your knowledge you learned previously, therefore it affects your learning satisfaction. When you use interactive material, your confusion can be easily

assessed, you can know it on the spot, when you don't use it you will stay in the puzzle of your confusion.

- 8 Do you agree that the use of critical and positive thinking skills are affecting learning satisfaction, but the strength of influence does not depend on whether teachers are using interactive materials or not?

From your experience, do you apply similar level of critical and positive thinking skills in teacher training with and without interactive materials? (slide 10)

- 8.1 We do not agree with this result. It depends on the subject and what they are doing at that time. When they are not using it, it does not stay on the same level, when we use it we do feel more use of critical and positive thinking skills.

It does affect, when you use it the learning satisfaction increases. When you do lesson planning, when we use it we have better quality of lesson planning.

It's not on the same level, there are many options to choose they can find the correct answer they then become confident with the contents and then they obtain better outcomes.

- 8.2 Interactive materials require more critical and positive thinking because when we assess myself in using it I notice what we are not good at, we need to use critical thinking skills to reach positive learning outcome.

When using interactive materials, it is more helpful, when you don't use interactive material, it is less clear, liking walking on the wood.

We do feel the use of critical and positive skills in two contexts will result in different learning outcomes.

- 8.3 Teacher 1: If we do not have interactive materials it could have been the same. For interactive materials we know how much we have learned, if we do not have we might have use critical thinking skills to figure out the learning materials.

Teacher 2: It won't be the same. Some materials you can be critical, you can use those skills, some materials you don't want to deal with it means you are not using the skills towards the materials. But we use critical thinking skills toward interactive material.

They find different answers from the interactive materials, interactive materials also helps confirm the knowledge that teachers have, which results in better learning satisfaction.

- 8.4 Critical and positive thinking skills. We agree. Because attitudes towards it is the same the outcome is the same.

8.5 Yes, I agree. Because regardless of using interactive material, you use same level of critical and positive thinking. It will resolve into same level of satisfaction. There isn't much difference if I don't know something, if there is interactive material, I will use my critical thinking skills and think whether I would read or go to people to get information. When you use it, it is just for self-assessment, you use same level of critical and positive thinking skills to ask for information.

9 Do you agree that the use of planning and organizing skills are affecting learning satisfaction, but the strength of influence does not depend on whether teachers are using interactive materials or not?

From your experience, do you apply similar level of planning and organizing skills in teacher training with and without interactive materials? (slide 11)

9.1 It should stay the same.

It has effect to this relationship. Regardless of using interactive materials, that satisfaction stays positive, it can be less satisfying without using interactive materials because they do not identify what they do not know. It affects positively, lesson planning they find what they don't know, and they can compare information to the web (think critically).

We want to learn how to make this material, we want to actually show the materials to students with actual movements. We can add the animation that how it grows. Just letting us use does not bring satisfaction.

9.2 When we use it, it gives more satisfaction it's like a guidance, it guides us to plan well. When using interactive material, we are going towards one direction, we follow the guidance, we feel more satisfied in using interactive material. There should be a difference.

9.3 One teacher agrees. One teachers think differently.

Disagree: when she delivers the contents, she feels more organized.

Agree: regardless of using interactive materials, you need the planning skills, that will result in higher learning satisfaction.

What kind of planning and organizing skills you have applied in dealing with teacher training?

When doing teacher training, we gather all teachers and give information. One deliver contents of the teacher training materials.

Individually we plan ourselves, we plan what we need to learn, later on we make plan on time, when to read, place to read, that's how we organize our teacher training materials. Based on what we read, we plan and organize how to make contents simple to students.

- 9.4 Planning and organizing skills. We get prompt feedback, that affects our learning satisfaction. When you use interactive materials, they know what to research for, that trigger better quality in planning and thus results in better satisfaction
- 9.5 Agree with that. Regardless on use of interactive material, you have to make a plan, even if you use it, you have to make a plan, even if you are not using interactive material, you need, so it affects satisfaction.

\*\* So, you feel the plan you make in both scenario have same effects on satisfaction.

Yes, it does.

- 10 Do you agree that effort regulation has no effect on learning satisfaction regardless of the teacher training materials you use?
- 10.1 Regardless of using interactive materials, we will give our effort even if we do not use we will give effort in learning teacher training. The more effort they give more satisfied teachers are. The more effort they give, we should have more learning satisfaction. Logically thinking, effort will affect learning satisfaction.

My interpretation, this factor is less important than the other ones.

- 10.2 One agrees, one disagrees. It depends on people's skills, when you use interactive materials, your effort becomes more active.
- 10.3 Disagree: one you are making effort there is an outcome, when not making effort there is no outcome. All teachers agree. When we use interactive material, effort will affect satisfaction. Even if you are making a lot of effort, there may be times when you are not satisfied with where you are.
- 10.4 Effort regulation. We don't agree. Because we feel there is better outcome due to the effort we make.
- 10.5 I disagree on this one. Regardless of interactive material, when they want to learn something they use their effort.

\*\* But here it means make effort even if it is boring.

I agree with this now. It doesn't affect satisfaction that much because even if someone has to do it, or being forced to do it, their satisfaction will not change even if they give effort.

That means if you force it, it looks like he does give effort, but outcome is not affected.

I think effort regulation doesn't affect satisfaction, satisfaction level does not increase if the teacher is forced to learn.