

**EFFECTS OF PROBLEM-SOLVING
STRATEGIES ON ACHIEVEMENT AND
MOTIVATION IN LEARNING CHEMISTRY
IN A SOCIAL NETWORK ENVIRONMENT**

TAN HONG LOOI

UNIVERSITI SAINS MALAYSIA

2016

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IN A SOCIAL NETWORK ENVIRONMENT**

by

TAN HONG LOOI

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

November 2016

ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere gratitude to my supervisor, Associate Professor Dr. Wan Ahmad Jaafar b. Wan Yahaya whose expertise, generous patience and constant motivation that made it possible for me to go on throughout my years of study.

I am also thankful to my co-supervisors, Associate Professor Dr. Toh Seong Chong and Professor Dr. Balakrishnan Muniandy for the continuous support and great assistance on my Ph.D study and research.

My heartfelt thanks to all the research proposal committees, Professor Dr. Wan Mohd Fauzy Wan Ismail, Professor Dr. Irfan Naufal Umar and Associate Professor Dr. Mona Masood for their valuable comments and reviews on the early draft that were quite useful.

I would also like to thank all the expert Chemistry teachers who had helped me out during the validation and data collection. I am gratefully indebted to their cooperation and helpful ideas on the thesis.

Special appreciation is directed to the principals, teachers and students of SMK Convent Lebu Light, SMK Tanjong Bunga, SMK Sultan Abdul Aziz, SMK Raja Muda Musa, SMK Convent Teluk Intan and SMK Horley Methodist for helping me in the pilot study as well as actual study.

I would like to acknowledge the Malaysian Education of Planning and Research Department and the State Education Department of Penang and Perak for granting me the permission to conduct my research in the schools.

I would also like to express my utmost gratitude to my fellow course mates who encourage and motivate me to go on and most of all, helping me to take care of

my son when I was busy in the meeting with supervisors. I am very grateful to all the people who have helped me directly or indirectly in my research.

Above all, I must express my very profound gratitude to my husband, Mr. Tan Heng Lee, for his love, patience and moral support. Gratitude and special appreciation are also extended to my parents, Mr. Tan Kok Heng and Mdm. Nancy Ooi Poh Lian; my beloved sisters, Tan Hong Li and Tan Hong Lynn, who have unfailingly supported me throughout the study. I also wish to say thank you to my son, Terence Tan Yi Ler for traveling with me to and fro from Penang to Perak during my study and his continuous encouragement for me to do well in my study.

Last but not least, I wish to dedicate this research to my late mother, Mdm. Fong Wai Lan, who will always be the great inspiration in my life. This accomplishment would not be possible without her.

TABLES OF CONTENTS

ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iv
LIST OF TABLES	ix
LIST OF FIGURES	xiv
LIST OF APPENDICES	xvi
LIST OF ABBREVIATION	xvii
ABSTRAK	xviii
ABSTRACT	xx
CHAPTER ONE: INTRODUCTION	
1.1 Overview	1
1.2 Background of the study	2
1.2.1 Preliminary Investigation	6
1.3 Problem Statement	8
1.4 Research Objectives	12
1.5 Research Questions	13
1.6 Research Hypotheses	15
1.7 Research Framework	18
1.8 Theoretical Framework	19
1.9 Significance of the study	22
1.10 Limitation of the study	23
1.11 Operational Definition	23
1.12 Summary	26
CHAPTER TWO: LITERATURE REVIEW	
2.0 Introduction	27
2.1 Problems in Learning Chemistry	27

2.2	Constructivist Teaching and Learning of Chemistry	28
2.3	Piaget's Theory of Cognitive Development	31
	2.3.1 The theoretical perspective of personal constructivism	32
2.4	Vygotsky's Theory of Social Development	33
	2.4.1 The theoretical perspective of cooperative learning	34
2.5	Problem-based Learning	36
2.6	Learning Strategies	39
	2.6.1 A meta-analysis of the learning strategies	39
	2.6.2 Individual Problem-based learning and Collaborative Learning as Learning Strategies	40
	2.6.3 The integration of iPBL and CL as learning strategies for the teaching and learning of Chemistry	47
	2.6.4 Learning strategies and Students' Achievement	49
	2.6.5 Learning strategies and Perceived Motivation	51
	2.6.6 Learning strategies and Retention	55
	2.6.7 Learning strategies and Learning Style	57
	2.6.7.1 Active-Reflective Learners	58
2.7	Social Network Site in Education	59
	2.7.1 The perspective of Social Network Site in Chemistry Education	59
	2.7.2 Social Network Site in Students' Performance and Motivation	61
	2.7.3 Social Network Site as Constructivist Learning Environment	62
2.8	Motivation and Learning	63
	2.8.1 The study of motivation	63
	2.8.2 The ARCS model	64
2.9	Conceptual Framework	66
2.10	Summary	67
 CHAPTER THREE: METHODOLOGY		
3.0	Introduction	68
3.1	Research Design	68
	3.1.1 Internal and External Validity of the Research Design	69

3.2	Research Population and Sample	74
3.3	Research Variables	75
3.4	Research Instruments	76
	3.4.1 Demographic Questionnaire	77
	3.4.2 Felder and Soloman's Index of Learning Styles Questionnaire	77
	3.4.3 Pre-test, Post-test and Retention	78
	3.4.4 Keller's IMMS	79
	3.4.5 Instructional Materials	79
3.5	Research Procedure	82
3.6	Data Collection and Analysis	87
3.7	Pilot study	87
	3.7.1 Data analysis of the pilot study	92
	3.7.2 Suggestion for actual study	93
3.7	Summary	94

CHAPTER 4: RESULTS & DATA ANALYSIS

4.0	Introduction	95
4.1	Characteristic of the sample	95
	4.1.1 Classification of learners according to learning style	96
4.2	Homogeneity test of the groups	97
	4.2.1 Pre-test score analysis for homogeneity	97
4.3	Assumption of ANOVA and ANCOVA	98
	4.3.1 Assumption 1: Independence of Observation	99
	4.3.2 Assumption 2: Test of Normality	99
	4.3.3 Assumption 3: Reliability of Covariate	105
	4.3.4 Assumption 4: Linearity	106
	4.3.5 Assumption 5: Homogeneity of the regression slopes	107
	4.3.6 Assumption 6: Homogeneity of Variance of the Dependent Variable	108
4.4	Statistical Analysis of Results corresponding to Research Hypotheses	109
	4.4.1 ANOVA and ANCOVA tests for Hypothesis A	109
	4.4.1(a) Testing of H_{0A1}	109
	4.4.1(b) Testing of H_{0A2}	111
	4.4.1(c) Testing of H_{0A3}	112

4.4.2	ANCOVA tests for Hypothesis B	113
4.4.2(a)	Testing of H_{oB1}	113
4.4.2(b)	Testing of H_{oB2}	115
4.4.2(c)	Testing of H_{oB3}	116
4.4.2(d)	Testing of H_{oB4}	118
4.4.3	ANOVA tests for Hypothesis C	120
4.4.3(a)	Testing of H_{oC1}	120
4.4.3(b)	Testing of H_{oC2}	121
4.4.3(c)	Testing of H_{oC3}	122
4.4.3(d)	Testing of H_{oC4}	124
4.4.4	ANOVA tests for Hypothesis D	125
4.4.4(a)	Testing of H_{oD1}	125
4.4.4(b)	Testing of H_{oD2}	126
4.4.4(c)	Testing of H_{oD3}	128
4.4.4(d)	Testing of H_{oD4}	129
4.5	Interaction Effects between the Learning Strategies and Learning Style in students' achievement, perceived motivation and retention	131
4.5.1	Testing of H_{oE1}	131
4.5.2	Testing of H_{oE2}	133
4.5.3	Testing of H_{oE3}	135
4.6	Summary of Findings	138

CHAPTER 5: DISCUSSION AND CONCLUSION

5.0	Introduction	144
5.1	Discussion of the Research Findings	145
5.1.1	The effect of using two learning strategies towards students' achievement, perceived motivation and retention	145
5.1.2	The effect of using two learning strategies associate with active - reflective learning style towards students' achievement	147
5.1.3	The effect of using two learning strategies associate with active - reflective learning style towards students' perceived motivation	149
5.1.4	The effect of using two learning strategies associate with active - reflective learning style towards students' retention	150
5.1.5	Interaction effects between the learning strategies and learning style toward students' achievement, perceived motivation and retention	152
5.2	Implication of the study	153

5.3	Limitation of the study	156
5.4	Recommendation for the future study	157
5.5	Summary and Conclusion	158
	REFERENCES	160
	APPENDICES	174
	LIST OF PUBLICATION	

LIST OF TABLES

		Page
Table 2.1	The differences between self-directed learning and self-regulated learning (Loyens, Magda & Rikers, 2008)	41
Table 2.2	Comparison between PBL and iPBL (modification of Barrows' problem-based teaching model, 1986)	45
Table 2.3	The differences between collaborative learning and cooperative learning	46
Table 2.4	The Components of ARCS and Strategies in accordance with instructional strategies (Adapted from Keller, 1983)	53
Table 2.5	Conception of learning in the Inventory of Learning Styles	57
Table 2.6	Chemistry in Facebook website	59
Table 2.7	Intrinsic and Extrinsic Motivation (Huitt, 2005)	64
Table 3.1	Summary of threats to internal validity and its solution	70
Table 3.2	Threats to external validity and its solution	72
Table 3.3	Chemistry tutorial videos from Youtube	80
Table 3.4	Procedures of conducting learning strategies in social network environment (adapted from Kirschner, Paas & Kirschner, 2009)	86
Table 3.5	The results of the reliability test for the instruments	89
Table 3.6	The results for the reliability statistic	89
Table 3.7	Descriptive statistics for pretest, posttest I & II and retention	92
Table 3.8	Descriptive statistics for IMMS	93
Table 4.1	Learning style preference based on "a" responses	96
Table 4.2	The number of students divided by groups	96
Table 4.3	ANOVA of achievement mean scores for school and learning strategy approaches	98
Table 4.4	Levene's Test of Equality of Error Variances	98
Table 4.5	The assumptions of ANOVA and ANCOVA	99

Table 4.6	Test of Normality for pre-test, post-test and retention	100
Table 4.7	Test of Normality for perceived motivation	104
Table 4.8	Skewness and Kurtosis values for perceived motivation	104
Table 4.9	Cronbach's Alpha value for the pre-test	105
Table 4.10	Homogeneity of regression slopes test for learning style	108
Table 4.11	Homogeneity of regression slopes test for learning strategies	108
Table 4.12	Test of Homogeneity of Variances for knowledge across the iPBL group and CL group	108
Table 4.13	Descriptive statistic for the pre-test and post-test score for the iPBL group and CL group	109
Table 4.14	ANCOVA analysis for students' achievement across iPBL group and CL group	110
Table 4.15	Descriptive statistic of perceived motivation for iPBL group and CL group	111
Table 4.16	Levene's Test of Equality of Error Variances	111
Table 4.17	Robust Tests of Equality of Means	112
Table 4.18	Descriptive Statistic of students' retention for iPBL group and CL group	112
Table 4.19	Levene's Test of Equality of Error Variances	113
Table 4.20	ANOVA of retention score by the two learning strategies	113
Table 4.21	Descriptive Statistic of students' achievement between active – reflective learners of iPBL strategy	114
Table 4.22	Levene's Test of Error Variances	114
Table 4.23	ANCOVA of achievement score by learning style with pre-test score as covariate	114
Table 4.24	Descriptive statistic of students' achievement between active – reflective learners of CL strategy	115
Table 4.25	Levene's Test of Error Variances	116

Table 4.26	ANCOVA of achievement score by learning style with pre-test score as covariate	116
Table 4.27	Descriptive Statistic of students' achievement between active learners of iPBL and CL strategies	117
Table 4.28	Levene's Test of Error Variances	117
Table 4.29	ANCOVA of achievement score by learning strategies for active learners with pre-test score as covariate	117
Table 4.30	Descriptive statistic of students' achievement between reflective learners of iPBL and CL strategies	118
Table 4.31	Levene's Test of Error Variances	118
Table 4.32	ANCOVA of achievement score by learning strategies for reflective learners of iPBL and CL strategies with pre-test score as covariate	119
Table 4.33	Robust Tests of Equality of Means	119
Table 4.34	Descriptive statistic of students' perceived motivation between active – reflective learners of iPBL strategy	120
Table 4.35	Levene's Test of Error Variances	120
Table 4.36	One-way ANOVA of perceived motivation between active – reflective learners of iPBL strategy	121
Table 4.37	Descriptive statistic of students' perceived motivation between active – reflective learners of CL strategy	121
Table 4.38	Levene's Test of Error Variances	122
Table 4.39	ANOVA of perceived motivation between active – reflective learners of CL strategy	122
Table 4.40	Descriptive statistic of students' perceived motivation between active learners of iPBL and CL strategies	123
Table 4.41	Levene's Test of Error Variances	123
Table 4.42	ANOVA of perceived motivation for active learners of iPBL and CL strategies	123
Table 4.43	Descriptive statistic of students' perceived motivation between reflective learners of iPBL and CL strategies	124

Table 4.44	Levene's Test of Error Variances	124
Table 4.45	ANOVA of perceived motivation for reflective learners of iPBL and CL strategies	125
Table 4.46	Descriptive statistic of students' retention between active – reflective learners of iPBL strategy	125
Table 4.47	Levene's Test of Error Variances	125
Table 4.48	ANOVA of retention between active – reflective learners of iPBL strategy	126
Table 4.49	Descriptive statistic of students' retention between active – reflective learners of CL strategy	127
Table 4.50	Levene's Test of Error Variances	127
Table 4.51	ANOVA of retention for active – reflective learners of CL strategy	127
Table 4.52	Descriptive statistic of students' retention between active learners of iPBL and CL strategies	128
Table 4.53	Levene's Test of Error Variances	128
Table 4.54	ANOVA of retention for active learners of iPBL and CL strategies	129
Table 4.55	Descriptive statistic of students' retention between reflective learners of iPBL and CL strategies	129
Table 4.56	Levene's Test of Error Variances	130
Table 4.57	ANOVA of retention between reflective learners of iPBL and CL strategies	130
Table 4.58	Robust Tests of Equality	131
Table 4.59	Descriptive statistic of the learning strategies and learning style on achievement score	131
Table 4.60	Two-way ANOVA of achievement score by learning strategies and learning style	132
Table 4.61	Descriptive statistic of learning strategies and learning style on perceived motivation	134
Table 4.62	Two-way ANOVA of perceived motivation by learning	134

	strategies and learning style	
Table 4.63	Descriptive statistic of learning strategies and learning style on retention	136
Table 4.64	Two –way ANOVA of retention by learning strategies and learning style	136

LIST OF FIGURES

	Page	
Figure 1.1	Learning Japanese on Facebook	5
Figure 1.2	Research Framework	18
Figure 1.3	Model for designing CLEs (Jonassen, 1999)	20
Figure 1.4	The theoretical framework	21
Figure 2.1	Piaget's Four Stages of Cognitive Development	31
Figure 2.2	The difference between traditional learning and PBL	37
Figure 2.3	The proposed model of iPBL	42
Figure 2.4	The PBL flowchart (Loyen et al., 2008)	43
Figure 2.5	The proposed iPBL flowchart	44
Figure 2.6	The four aspects of collaborative learning (Dillenbourg, 1999)	47
Figure 2.7	How Collaboration Improves Learning (adopted from Slavin, 1995)	50
Figure 2.8	Keller's Macro Model of Motivation and Performance (Adapted from Keller, 1979, 1983b)	52
Figure 2.9	Conceptual Framework	66
Figure 3.1	The Quasi-experimental Design of this study	73
Figure 3.2	Learning strategies mode by active-reflective learning styles	73
Figure 3.3	The research design	74
Figure 3.4	The research variables	75
Figure 3.5	Uploaded video clip in Facebook as an instructional material	79
Figure 3.6	Crime Scene Investigation game as uploaded in the Facebook	81
Figure 3.7	The assigned treatment to schools	83

Figure 3.8	The Graphical Illustration of Research Procedure	85
Figure 3.9	The sample Facebook page of Chempage CL	90
Figure 3.10	The sample Facebook page of Chempage iPBL	91
Figure 4.1	Histogram of pre-test for the sample	101
Figure 4.2	Normal probability plot of the pre-test for the sample	101
Figure 4.3	Histogram of the post-test for the sample	102
Figure 4.4	Normal probability plot of the post-test for sample	102
Figure 4.5	Histogram of the retention test for the sample	103
Figure 4.6	Normal probability plot of the retention test for the sample	103
Figure 4.7	Histograms of IMMS score for iPBL group and CL group	105
Figure 4.8	Normal probability plots of the IMMS score for iPBL group and CL group	105
Figure 4.9	Scatter plot across pre-test and post-test for iPBL group	106
Figure 4.10	Scatter plot across pre-test and post-test for the CL group	107
Figure 4.11	Plot of interaction between learning strategies and learning style on achievement	133
Figure 4.12	Plot of interaction between learning strategies and learning style on perceived motivation	135
Figure 4.13	Plot of interaction between learning strategies and learning style on retention	137

LIST OF APPENDICES

	Page	
Appendix A	Demographic Questionnaire	174
Appendix B	Felder & Solomon's Index of Learning Styles Questionnaire	179
Appendix C	Pre test	181
Appendix D	Post-test I (Topic 3.1 to Topic 3.3)	188
Appendix E	Post-test II (Topic 3.4 to Topic 3.6)	195
Appendix F	Retention test	205
Appendix G	Table of Test Specification (Jadual Spesifikasi Ujian)	212
Appendix H	Sample of validation form for Pre test and Post-test	216
Appendix I	Keller's Instructional Materials Motivation Scale (IMMS)	244
Appendix J	Permission Letters from EPRD and JPN	248
Appendix K	Consent Letter for Parents	253

LIST OF ABBREVIATION

CL	Collaborative Learning
CSI	Crime Scene Investigation
FB	Facebook
iPBL	Individual Problem-based Learning
MKO	More Knowledgeable Other
MOE	Ministry of Education
SDL	Self-directed learning
SNS	Social Network Sites
SPM	<i>Sijil Pelajaran Malaysia</i>
SRL	Self-regulated learning
ZPD	Zone of Proximal Development

**KESAN STRATEGI PENYELESAIAN MASALAH TERHADAP
PENCAPAIAN DAN MOTIVASI BAGI PEMBELAJARAN KIMIA
DALAM PERSEKITARAN LAMAN SOSIAL**

ABSTRAK

Kajian ini dijalankan bagi mengkaji kesan dua strategi pembelajaran berasaskan masalah terhadap pencapaian kimia dan motivasi pelajar dengan menghubungkan stail pembelajaran. Dua strategi pembelajaran berasaskan masalah ialah Pembelajaran Berasaskan Masalah secara individu dan Pembelajaran Kolaboratif. Bahan instruksi yang sama dan telah disah dan digunakan oleh guru yang berpengalaman dengan mengikuti protokol yang ditetapkan untuk selama dua bulan. Topik formula dan persamaan kimia diajar dalam bulan pertama. Selepas satu bulan, ujian ingatan kembali dijalankan untuk melihat sejauh mana maklumat yang dapat dikekalkan dalam ingatan pelajar dengan penggunaan dua strategi pembelajaran tersebut. Kajian ini menggunakan reka bentuk kuasi-eksperimen ujian pra dan ujian pasca dengan kumpulan kawalan tidak setara. Bilangan pelajar yang terlibat dalam kajian ini ialah 155 orang pelajar tingkatan empat aliran sains dari empat buah sekolah menengah kebangsaan di kawasan bandar. Pembolehubah bebas merangkumi dua strategi pembelajaran berasaskan masalah dan pembolehubah bersandar ialah pencapaian kimia yang merangkumi pengekalan serta motivasi pelajar. Manakala pembolehubah moderator ialah stail pembelajaran berdasarkan satu dimensi Indeks Stail Pembelajaran daripada Felder dan Silverman, iaitu stail pembelajaran aktif dan reflektif. Dua strategi pembelajaran ini memberi kesan yang berlainan

terhadap pencapaian dan ingatan kembali. Kajian ini dapat menyimpulkan bahawa strategi pembelajaran berasaskan masalah secara individu lebih efektif dalam ingatan jangka panjang manakala pembelajaran kolaboratif lebih sesuai untuk ingatan jangka pendek. Kajian ini juga mendapati kedua-dua strategi pembelajaran memanfaatkan pelajar yang berstail aktif atau reflektif. Secara umumnya, dengan mengintegrasikan laman sosial dalam pendidikan, kedua-dua strategi pembelajaran mempunyai potensi untuk menggalakkan pencapaian dan meningkat motivasi pembelajaran.

**EFFECTS OF PROBLEM-SOLVING STRATEGIES ON
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ABSTRACT

This study was conducted on the basis of finding out the effects of two problem-based learning strategies on students' chemistry achievement and learning motivation by relating the learning strategies with learning style. The two modes of Problem-based learning strategies are Individual Problem-based learning and collaborative learning, using similar validated instructional materials and were taught by experienced teachers following the protocols for a period of two months. The topic of Chemical Formulae and Equation was taught in the first month and after the second month, a retention test was performed to investigate how much information was retained by using the two learning strategies. The study employed quasi-experimental design in a non-equivalent control group pretest-posttest design. The sample involved were 155 Form Four students from four urban national secondary schools. The independent variables were the two learning strategies and the dependent variables were the achievement which included the retention and also the learning motivation; the moderator variable was the learning style based on one dimension of Felder and Silverman's Index of Learning Style, i.e. active and reflective learning style. The two learning strategies had different results in attainment and the retention. This study concluded that Individual Problem-based Learning was more effective in retention and the Collaborative Learning was effective for the attainment in a short term

period. This study had found that both Individual Problem-based Learning and Collaborative Learning were equally beneficial for both active and reflective learners. By integrating social network in education, both learning strategies have their positive potential of enhancing the achievement and also increasing learning motivation.

CHAPTER ONE

INTRODUCTION

1.1 Overview

The education system, especially in Science and Mathematics, in Malaysia has gone through vast changes these few years. Since 2000, the integration of constructivist learning method in Chemistry has led to a new paradigm shift of teaching strategies. Although teachers had been through the introductory courses, teachers still lack of expertise training and readily accessible constructivist materials to implement the constructivist teaching method. Students also have faced the issue of difficulty in learning Chemistry especially when they are unable to understand the basic mole concept and memorise the chemical formulae. These topics are the fundamental base for Chemistry and they have to prepare themselves for the *Sijil Pelajaran Malaysia* (SPM) later on.

Therefore, the main focus of this study is to investigate the effectiveness of learning strategies by using a social network site as a support learning tool in enhancing students' performance in the topic of Chemical Equation and Formulae. Problem-based learning strategies based on multimedia constructivist environment to solve the learning difficulties in chemistry were used in this study. This chapter also presents the background of this study, problem statements, preliminary studies and objectives of the study. A brief description of research questions, hypothesis, operational definition and the significance of the study are included.

1.2 Background of the study

Chemistry is full of abstract concepts that many students find it hard to comprehend (Chan, 1988; Muth & Guzman, 2000). Students feel that the subject itself is very confusing and complicated. This scenario has become an international issue when there is a huge decline in the number of students taking Chemistry in secondary and tertiary education (Breuer, 2002; Hill & Cross, 2001; Price & Hill, 2004). Breuer (2002) suggested the possible reason of this worrying trend could be the perceived intrinsic difficulty of the subject, the negative public image of the discipline and career prospects. Price and Hill (2004) also support the fact that Chemistry has gained low public perception and the lack of its identity are the reason why the number of Chemistry students had declined tremendously over the years. As an effort to overcome the issue, Malaysian Ministry of Education (MOE) has implemented 60:40 policy in year 2001 which clearly stated that student who obtained grade C in *Penilaian Menengah Rendah (PMR)* Science and Mathematics must enrol into science stream. The policy targeted to achieve 60% enrolment to Science stream and 40% to Art stream. The policy is still in line with the Education Development Plan 2013 -2025. However the education system for the lower secondary has changed where the public examination (PMR) is replaced by Pentaksiran Tingkatan Tiga (PT3) and in late December 2014, a new requirement stated that students are “encouraged” to enter Science stream if their PT3 results for science is grade B or band 4. According to Agogo and Otor (2013), chemistry is the mother of all sciences. Therefore, Chemistry is seen as the central focus of all sciences and it is made a compulsory subject in science stream. In other words, students, who are not interested

in Chemistry, are required to take up the subject. Hence, this lack of interest leads to the lack of motivation to learn.

Motivation is an important factor when it comes to learning (Keller, 2010). Without motivation to learn, students' performance is going to be affected. Motivation can influence a person's effort towards achieving a goal. To motivate students, teachers must know what excites students and also students' learning style. Fadlemula (2010) stated that teachers might need to screen and inspire the achievement goal that their students pursue if they want to improve the students' achievement. Students' learning strategies would have impacts on their performance and motivation too.

Many teachers would have agreed that classroom style like chalk and talk approach is totally out of date. Although all secondary schools have been provided with Chemistry courseware and some constructivist teaching had been introduced in the curriculum of teaching and learning of Science and Mathematics, the teaching of Chemistry in Malaysia is still very traditional. According to the Malaysian Ministry of Education (2003), these constructivist teaching strategies included

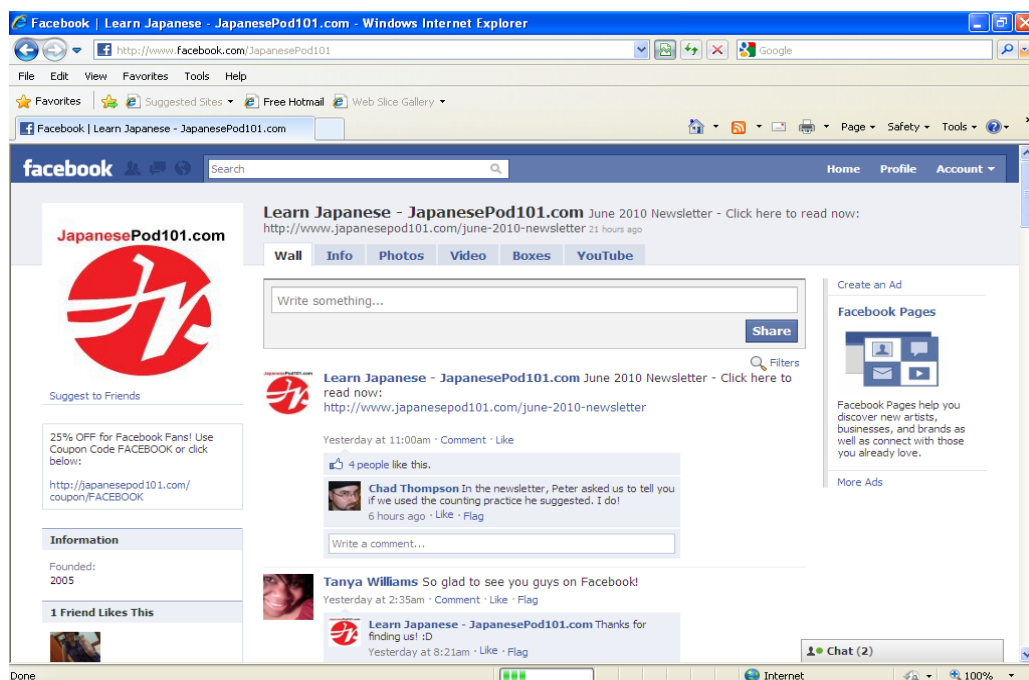
- (a) Teaching and learning are student-centred.
- (b) Experimental learning.
- (c) Contextual learning.
- (d) Creative and critical thinking.
- (e) Problem-solving based on information.
- (f) Practice of scientific method in learning.

Kong (2006) commented that modern educational theory is moving from the traditional recall of information or procedures into the areas of critical thinking, creative problem solving, analysis and evaluation which are very much needed in today's knowledge based economy.

The lack of communication between teacher and students causes the class to be boring. The mundane routine of displaying the courseware in class is also not helping the students to achieve a greater understanding of the subject. The students learning needs should be the top priority of every teacher. The effectiveness in any learning environment is based upon the types of learning style and the level of cognitive activity engendered in the students.

Malaysian Social Development Council had conducted a survey in the year 2013 and found out that 45.5% of the total population in Malaysia are Facebook users. The survey also showed that 16.3% of the users were teenagers aged between 13 and 17, who have their own blog and social network sites (The Borneo Post, 2013). These social media technologies are increasingly popular among students (and also adults) and can be seen as tools to bridge the gap between teachers and students in order to enhance teaching and learning. As defined by Hagardon (2008), social media would be a significant part of the future of learning. Although the internet provides many options for diversion, statistics by Nielsen (2010) show that one of the most likely places students are spending a portion of their class time is on Facebook. Facebook constitutes a rich site for researchers interested in the affordances of social networks due to its

heavy usage patterns and technological capacities that bridge online and offline connections (Ellison, Steinfield & Lampe, 2007). As likely as Facebook is to be a distraction in the classroom, it also has the potential to be a teaching tool when used strategically and creatively. For example, the Japanese online tutorial as shown in Figure 1.1 shows that, Facebook users who want to learn Japanese could learn Japanese through this Facebook page.



*Figure 1.1: Learning Japanese on Facebook
(Source: www.facebook.com/JapanesePod101)*

Hargadon (2008) stated that “what is abundantly clear is that no matter what our schools are currently doing, most of our students are already actively involved in this content creation and conversation outside of school”. In fact, Social Network Site (SNS) can be seen as a supplementary educational tool for all teachers and students. Solvie and Kloek (2007) also supported the idea that technology tools like SNS can be used to

engage students with different learning styles in a constructivist environment. It is the role of the teacher that he or she modify or use the tools through a collection of instructional strategies into constructivist environment to encourage each student's individual learning (Miller, 2002). Miller (2002) also mentioned that to identify the interplay between constructivism and different learning styles is difficult, because there are many combinations of instructional strategies to teach students of all learning styles. However, Miller (2000) also states that since constructivist approach is based on “learners control their own learning”, therefore, it does not matter what student’s learning styles are. Miller (2002) agrees that teachers, who have constructivist ideology, are in better position to teach students of all learning styles.

1.2.1 Preliminary Investigation

A preliminary investigation (PI) had been conducted to validate the research content by conducting a survey in three Secondary schools in Penang. The participants in this survey included 80 students and 5 Chemistry teachers. In the survey, students and teachers were asked to provide some family backgrounds, Internet usage and opinions about social network usage and the problems in teaching and learning of Chemistry.

All the Chemistry teachers agreed that students have difficulties in understanding the basic concept of Chemistry, especially when it comes to the mole concept. One teacher commented that if the basic concept is not grasped by the students, they would find it hard to understand the next topics. Three teachers expressed that constructivist teaching strategies are very ideal but it would take up a lot of time for teaching one

topic. As far as the teachers are concerned, they need to finish the syllabus on time to prepare the students for examination. As for students, they preferred that teachers allow them to learn at their own pace. Ten out of eighty students commented that teachers are just “dumping” information on them without knowing whether the students understand the learning content or not. Hence, it is important to find ways to teach them or guide them on how to learn the concepts by themselves. Students’ learning strategies should be in line with their learning styles in order to improve their performance.

In this study, learning style is also determined from the questionnaire given. Learning style in this study comprises two modes: Active-Reflective. This is to provide an insight on how students learn and thus, help teachers to prepare their teaching materials or content to stimulate learning desire.

Seventy-five students and all the teachers agreed that social network sites if properly handled, it could be used for educational purpose. Although 25% of the students had commented that Facebook might have negative impact in their study, forty students were positive that the social network sites might enhance learning. From this survey, it can be seen clearly that students were motivated to learn if social network sites are used in education. A survey to investigate the frequency of students and teachers using the Facebook during school dismissal and school holidays was also conducted. It had become a habit that after school dismissal, most of the students and teachers would login to Facebook. This survey had provided a useful insight into the time use and behavioural pattern of students and teachers. From this survey, it is nearly 90%

participation of students and teachers in the Facebook, which makes Facebook a useful tool and interesting subject for educational research. Thus, PI had shown that the research problem is relevant and it is necessary to investigate the issue of using social network website for a good educational purpose.

The PI also showed that problem arises when the teacher and students could not communicate well, especially in terms of teaching and learning. Therefore, by using social network site e.g. Facebook to bridge the gap between teacher and students could help to overcome this issue. Furthermore, if students were allowed to explore the learning content at their own pace in their own social network site, this would not just only accommodate their learning styles, but with the guide of some learning strategies, this could also bring out the joy of learning in them.

1.3 Problem Statement

Chemistry students are often fed with descriptive symbols, concepts and theories for memorisation and students' involvement in the intellectual processes is not significant (MacMillan, 1992). This leads to a situation where students have difficulties to understand the concept of basic Chemistry. Chemistry is always seen as an abstract subject (Stieff & Wilensky, 2002; Agogo & Onda, 2014) of which most of the Form Four students find it hard to understand the principles and theoretical aspects of the basic Chemistry, especially in the topic of mole concept (Krishnan & Howe, 1994; Yalcinalp, Geban & Ozkan, 1995). Kong (2006) stated that the Malaysian Form Four students who are still at the concrete operations level or early formal operations level would

experience difficulty in understanding and applying a formal subject. She also suggested that due to the transitional position from concrete operations to formal operations, it is vital for teachers to design instructional strategies that would enable students to learn chemistry in a formal setting. The major challenge that teachers have to face is to transform their traditional teaching and learning to constructivist approach just to provide opportunities to students to explore their own learning (Rajendran, 2002).

Constructivism is seldom practise in Malaysian school (Kong, 2006), especially in the Problem-based Learning (PBL) setting. Tan & Mohd Yusof (2013) stated that there is limited research about PBL used in Malaysian Secondary School. Most of the teachers' method of teaching is still in the behaviourist manner (Abu Hassan, 2003; Lim, 2007, Ng, 2001, Tan & Mohd Yusof, 2013). Many research studies in Malaysia found that the issue of heavy workload faced by the Malaysian teachers (Koh, 2004; Lim & Hwa, 2007) due to the influence of examination oriented culture and 'finish syllabus syndrome', made teachers have less time or less initiative to adopt new teaching approaches in their lessons (Koo, 2008). Thus, it is vital that if the students could adopt a learning strategy which could help them to learn on their own instead of depending on the teacher.

Every student is different in the way they study. Thus, it is essential for the teacher to be aware that every student constructs knowledge differently in their minds (Taber, 2006). To facilitate learning that acknowledges the different learning styles of students, teachers need to be able to measure students' learning styles. Fletcher, Potts &

Ballinger (2008) stated that “an understanding of the preferred learning style of an individual provides an insight into the teaching methods that are likely to be most effective for that individual” (p.383).

Therefore, teaching and learning strategies not only need to accommodate students’ learning styles, but as well as applying constructivist strategies in the learning environment to motivate and enhance learning are very essential. Two constructivist learning strategies are applied in this study to match with students’ learning styles. The mentioned learning strategies are individual problem-based learning (iPBL) and collaborative learning (CL). CL is the most researched learning strategy (Jones & Jones, 2008). Many researchers have shown that CL is able to maximise learning and enhance academic accomplishment (Johnson & Johnson, 1994; Slavin, 1996; Williams, 2007). However, this is in contrast to Piaget’s belief. According to Piaget (1970), a child learns best when he could construct his own understanding. Piaget emphasized on the personal level of cognitive construction but there is only limited research on individual learning especially in the area of PBL (Tan & Mohd Yusof, 2013). Individual problem-based learning should be a research issue too as many Malaysian students are still lone learners as they have to complete their own homework by themselves.

Focusing on individual learning is essential especially when many research have shown that social network is making our society lonely (Marche, 2012; Turkle, 2011). The term “social isolation” is a scene caused by the substitution of the advanced technology for some neighbourhood involvement and the growing needs of people to

hide behind the computer rather than communicating with the one beside them. The social network is reducing the amount of face-to-face contact but gives the illusion of connection because it allows them to communicate interactively. Since all learning strategies promote knowledge construction to some degree, therefore, the learning environment is an important factor as to where the learning strategies should be applied to.

Learning environment should not be just in classroom scene. Apart from school, social network site, especially Facebook has played a significant part in students' life (Grosbeck, Bran & Tiru, 2011). What motivates students to spend more time in the social network site has been studied by other researchers. Many studies find that students use Facebook for social purpose but less for academic purpose ((Ellison, Steinfield & Lampe, 2007; Grosbeck et al., 2011; Hew, 2011). However, there are studies that show Facebook has its educational value. LaRue (2012) uses Facebook for classroom discussion and course management; Towner and Munoz (2011) agree that Facebook has its educational benefit in higher education and Towner and Munoz (2009) have conducted a study of Facebook in teacher education. Since social network site like Facebook has attracted the attention of students and by using it as a motivation factor to engage students in learning Chemistry should be explored.

In summary, the questions on how constructivist strategies could be applied to the social network environment in teaching Chemistry and how the strategies could help to facilitate learning to improve the performance and perceived motivation of students

shall be answered. Learning more about what motivates students to study Chemistry and indirectly enhance their performance is the most important key factor in this study to overcome the issue of attrition.

1.4 Research Objectives

This research aims to design an interactive instructional approach to the teaching of Chemical Equation and Formulae by applying two strategies in constructivist environment namely individual problem-based learning (iPBL) strategies and collaborative learning (CL) strategies. This study also focuses on the potential of using the social network site as a supporting tool to help students in learning Chemical Equation and Formulae. This research also analyzed the students' achievement, perceived motivation and retention after using social network sites as a supporting tool in their study.

The objectives of this research are:

1. To investigate the effect of two learning strategies i.e. iPBL and CL in social network environment towards students' achievement, perceived motivation and retention.
2. To investigate the effect of the two learning strategies i.e. iPBL and CL associate with active-reflective learning style in social network environment towards students' achievement.
3. To investigate the effect of the two learning strategies i.e. iPBL and CL associate with active-reflective learning style in social network environment towards students' perceived motivation.

4. To investigate the effect of two learning strategies i.e. iPBL and CL associate with active-reflective learning style in social network environment towards students' retention.
5. To investigate the interaction effect of two learning strategies and active-reflective learning style on students' achievement, perceived motivation and retention.

1.5 Research Questions:

A. What is the effect of using two learning strategies i.e. iPBL and CL in social network environment towards students' achievement, perceived motivation and retention?

1. Is there any significant difference in students' achievement between the two different learning strategy groups?
2. Is there any significant difference in students' perceived motivation between the two different learning strategy groups?
3. Is there any significant difference in students' retention between the two different learning strategy groups?

B. What is the effect of using two learning strategies i.e. iPBL and CL associate with active-reflective learning style in the social network environment towards students' achievement?

4. Is there any significant difference in students' achievement between active-reflective learners of iPBL strategy?
5. Is there any significant difference in students' achievement between active-reflective learners of CL strategy?

6. Is there any significant difference in students' achievement between active learners of iPBL and CL strategies?

7. Is there any significant difference in students' achievement between reflective learners of iPBL and CL strategies?

C. What is the effect of using two learning strategies i.e. iPBL and CL associate with active-reflective learning style in the social network environment towards students' perceived motivation?

8. Is there any significant difference in students' perceived motivation between active-reflective learners of the iPBL strategy?

9. Is there any significant difference in students' perceived motivation between active-reflective learners of the CL strategy?

10. Is there any significant difference in students' perceived motivation between active learners of the iPBL and CL strategies?

11. Is there any significant difference in students' perceived motivation between reflective learners of the iPBL and CL strategies?

D. What is the effect of using two learning strategies i.e. iPBL and CL associate with active-reflective learning style in the social network environment towards students' retention?

12. Is there any significant difference in students' retention between active-reflective learners of the iPBL strategy?

13. Is there any significant difference in students' retention between active-reflective learners of the CL strategy?
14. Is there any significant difference in students' retention between active learners of the iPBL and CL strategies?
15. Is there any significant difference in students' retention between reflective learners of the iPBL and CL strategies?

E. What is the interaction effect of two different learning strategies i.e. iPBL and CL and active-reflective learning styles on students' achievement, perceived motivation and retention?

16. Is there any significant interaction effect of two different learning strategies associate with active-reflective learning style in students 'achievement'?
17. Is there any significant interaction effect of two different learning strategies associate with active-reflective learning style in perceived motivation?
18. Is there any significant interaction effect of two different learning strategies associate with active-reflective learning style in retention?

1.6 Research Hypotheses

In this study, the hypotheses are formulated as null hypotheses. The null hypotheses are formed based on the research objectives and questions as follows:

A. The effect of using two learning strategies i.e. iPBL and CL in a social network environment towards students' achievement, perceived motivation and retention. The subsidiary null hypotheses are as follows:

H_{oA1} By controlling the pre-test score factor, there is no significant difference in students' achievement between the iPBL strategy and CL strategy.

H_{oA2} There is no significant difference in students' perceived motivation between the iPBL strategy and CL strategy.

H_{oA3} There is no significant difference in students' retention between the iPBL strategy and CL strategy.

B. The effect of using two learning strategies i.e. iPBL and CL associate with active-reflective learning style in the social network environment towards students' achievement. The subsidiary null hypotheses are as follows:

H_{oB1} By controlling the pre-test score factor, there is no significant difference in students' achievement between active-reflective learners of iPBL strategy.

H_{oB2} By controlling the pre-test score factor, there is no significant difference in students' achievement between active-reflective learners of CL strategy.

H_{oB3} By controlling the pre-test score factor, there is no significant difference in students' achievement between active learners of iPBL and CL strategies.

H_{oB4} By controlling the pre-test score factor, there is no significant difference in students' achievement between reflective learners of iPBL and CL strategies.

C. The effect of using two learning strategies i.e. iPBL and CL associate with active-reflective learning style in the social network environment towards students' perceived motivation. The subsidiary null hypotheses are as follows:

H_{oC1} There is no significant difference in students' perceived motivation between active-reflective learners of the iPBL strategy.

H_{oC2} There is no significant difference in students' perceived motivation between active-reflective learners of the CL strategy.

H_{oC3} There is no significant difference in students' perceived motivation between active learners of the iPBL and CL strategies.

H_{oC4} There is no significant difference in students' perceived motivation between reflective learners of the iPBL and CL strategies.

D. The effect of using two learning strategies i.e. iPBL and CL associate with active-reflective learning styles in the social network environment towards students' retention.

The subsidiary null hypotheses are as follows:

H_{oD1} There is no significant difference in students' retention between active-reflective learners of the iPBL strategy.

H_{oD2} There is no significant difference in students' retention between active-reflective learners of the CL strategy.

H_{oD3} There is no significant difference in students' retention between active learners of the iPBL and CL strategies.

H_{0D4} There is no significant difference in students' retention between reflective learners of the iPBL and CL strategies.

E. The interaction effect of two different learning strategies i.e. iPBL and CL and active-reflective learning style on students' achievement, perceived motivation and retention.

The subsidiary null hypotheses are as follows:

H_{0E1} There is no significant interaction effect of two different learning strategies and active - reflective learning style in students 'achievement.

H_{0E2} There is no significant interaction effect of two different learning strategies and active - reflective learning style in perceived motivation.

H_{0E3} There is no significant interaction effect of two different learning strategies and active - reflective learning styles in retention.

1.7 Research Framework

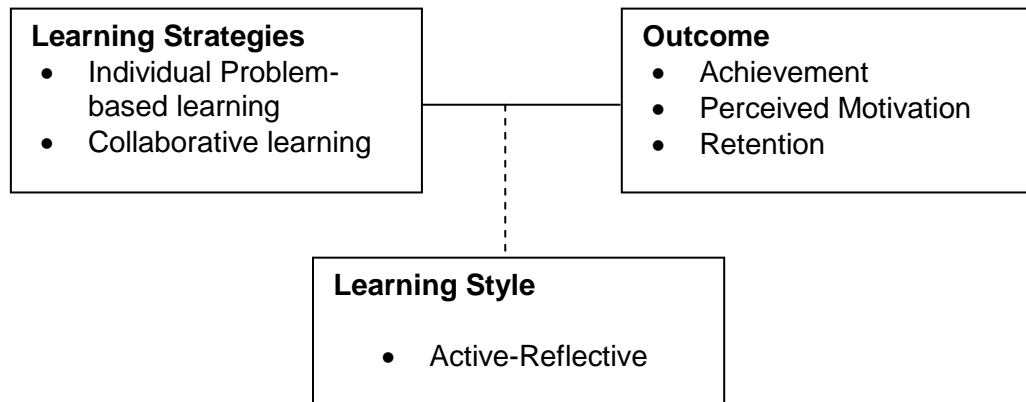


Figure 1.2: Research Framework

The research framework (as shown in Figure 1.2) is proposed to incorporate learning strategies and learning style to find out how the components affect the outcomes. The learning strategies are individual problem-based learning (iPBL) and

collaborative learning (CL). The learning style is one of dimension of Felder and Soloman's Index of Learning Style, which is, active-reflective learning. This study aims to find out which learning strategy is the best match with the learning style to enhance the students' achievement in Chemistry, promotes motivation and also retention.

1.8 Theoretical Framework

Constructivism serves as the guiding theoretical framework for this research. According to the constructivist perspective, learning occurs when learners are actively involved in constructing knowledge by fostering critical thinking to solve problems. Many constructivists agree that learning is more effective and meaningful if a student truly participates in the learning process (Pass, 2004; Sjoberg, 2007). In other words, the constructivist teaching strategies help to create motivated and independent student. The theoretical framework for this study is based on two constructivists' theories, namely Piaget's individual cognitive constructivism and Vygotsky's social constructivism. Pass (2004) noted that Piaget and Vygotsky provide a different path towards constructivism while Sjoberg (2007) classified Vygotsky as father of social constructivism and Piaget as a father of personal cognitive constructivism. The different ideas in constructivism lead to two different strategies used in this study which are individual problem-based learning strategy (iPBL) and collaborative learning strategy (CL). Individual problem-based learning strategy is based on Piaget's personal constructivism whereas collaborative learning strategy is based on Vygotsky's social constructivism.

Jonassen (1999) proposed a model for designing Constructivist Learning Environments (CLEs). The model consists of problem as the central focus of the environment with the related cases and information resources support system surrounding it. The original model is as Figure 1.3. However, the model is modified to serve as the macro model for the learning environment especially in the social network site and the two strategies which are iPBL and CL would be applied in the CLEs model (as shown in Figure 1.4).

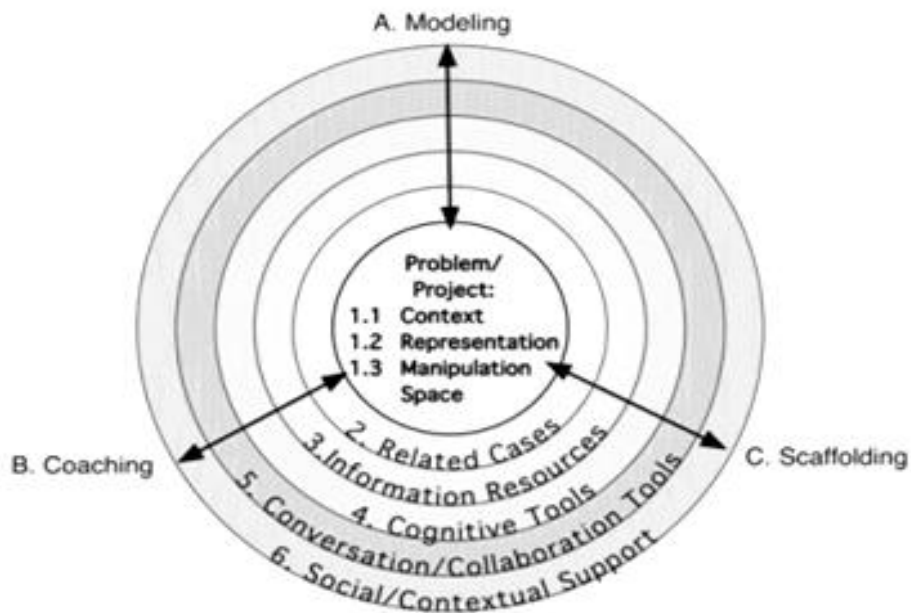


Figure 1.3: Model for designing CLEs (Source: Jonassen, 1999)