ARCS for Critical Information Retrieval Development

Suttipong Boonphadung

Abstract—The research on ARCS for critical information retrieval development aimed to (1) investigate conditions of critical information retrieval skill of the Mathematics pre-service teachers before applying ARCS model in learning activities, (2) study and analyze the development of critical information retrieval skill of the Mathematics pre-service teachers after utilizing ARCS model in learning activities, and (3) evaluate the Mathematics pre-service teachers' satisfaction on using ARCS model in learning activities as a tool to development critical information retrieval skill. Forty-one of 4th year Mathematics pre-service teachers who have enrolled in the subject of Research for Learning Development of semester 2 in 2012 were purposively selected as the research cohort. The research tools were self-report and interview questionnaire that was approved as content validity and reliability (IOC=.66-1.00, α =.834). The research found that critical information retrieval skill of the research samples before using ARCS model in learning activities was in the normal high level. According to the in-depth interview and focus group, the result however showed that the pre-service teachers still lack inadequate and effective knowledge in information retrieval. Additionally, critical information retrieval skill of the research cohort after applying ARCS model in learning activities appeared to be high level. The result revealed that the pre-service teachers are able to explain the method of searching, extraction, and selecting information as well as evaluating quality of information, and effectively making decision in accepting information. Moreover, the research discovered that the pre-service teachers showed normal high to highest level of satisfaction on using ARCS model in learning activities as a tool to development their critical information retrieval skill.

Keywords—Critical information retrieval skill, ARCS model, Satisfaction.

I. Introduction

EDUCATIONAL reform movement in Thailand is setting ambitious goals for student learning and educational quality. Many factors affecting the success of educational reform contribute to achieving these goals. However, the research has shown that the basis of high educational quality ultimately relies on teachers. Teacher with effective teaching quality seems to be the most important factors in raising both student achievement and educational quality assurance. This realization has led policy makers to demand professional development for teachers that will help them to enhance their knowledge and instructional practices [1].

As one example, The National Education Act of Thailand in 1999 requires teachers to create the ambiance, environment, instructional media, and facilities for learners to learn through the process of action research [2]. In doing so, teachers can then learn from and use classroom action research as a tool for

Suttipong Boonphadung is with the Faculty of Education, Suan Sunandha Rajabhat University, BKK, Thailand (Phone: +6687700-1348; fax: +662160-1060; e-mail: suttipong2511@ hotmail.com).

improving their teaching quality and classroom practice [3]. However, research revealed that the quality of classroom action research was not reach highest effective level. Furthermore, it was discovered that one of factors affecting quality of classroom action research is information retrieval skills [4]. Without proficiency in information retrieval, teachers tend to be unable to critically select information, relevance and appropriate source for conducting their classroom action research. Moreover, information retrieval skills are regarded as the basis for lifelong learning. This is because it enables teachers to master content and extend their investigation and research, become more self-directed, and critical thinking person [5], [6].

According to Jantarakantee et al. [7], professional teacher does not only relate to effective instructor, but also effective information retriever. This is so because a comprehensive understanding of information retrieval can guide their knowledge creation and activities that will affect their students' achievement and professional development. With the importance of critical information retrieval skills, the present research decided to develop pre-service teachers to be proficient critical information retrievers that can lead to professional teachers in the future. Hence, the pre-service teachers are able to develop a robust understanding of the role of information in their lives and profession, as well as, to model information retrieval to their future students.

II. Research Objectives

This research aimed to:

1. Investigate conditions of critical information retrieval skills of the pre-service teachers before applying ARCS model in learning activities;
2. Study and analyze the development of critical information retrieval skill of the pre-service teachers after utilizing ARCS model in learning activities;
3. Evaluate the pre-service teachers' satisfaction on using ARCS model in learning activities as a tool to development critical information retrieval skill.

III. Literature Review

A. Concept of Motivation and ARCS Model

Motivation is the force that initiates, guides, and maintains goal-oriented behaviors [8]. Motivation composes of expectation (belief of self-capacity), value (belief of worth doing), and emotion (emotional effect). Moreover, motivation can also be divided into intrinsic motivation and extrinsic motivation. Marton et al. (cited in [9]) indicated that when learners are intrinsically motivated, they tend to develop their competence, accomplishment, and excitement solely for

satisfaction of learning. On the other hand, Benson and Blackman viewed that extrinsic motivation based on a highly regarded outcome, rather than for internal forces. Rewarding with high score or good grades was used as intrinsic motivation as the approach to arouse learners' outcome to meet expectation. Although there have been arguments on the intrinsic and extrinsic motivation, these two types of motivation can effectively motivate learners to learn in order to reach expected achievement. Maynes et al. [10] further supported the point by stating that motivation starting from providing setting learning goals and allowing students to draw prior knowledge to construct a new knowledge. Additionally, it provides an opportunity for the instructor to collect information of learners as the way to design appropriate learning environment and teaching strategies for the learners [10]. More emphatically, Brophy (1998 cited in [11]) stated that in the context of classroom, using motivation can motivate learners to learn and willing to participate in classroom activities, and arouse learners' critical thinking. Brophy (1998 cited in [11]) goes on to suggest that the instructors need to provide opportunity for learners to construct knowledge by themselves and control their thoughts within the conceptual framework or subject matter.

Motivation theory in the form of ARCS model is regarded as one of the most effective strategy that can boost critical information retrieval skills of pre-service teachers. This is so because it is based upon (1) Expectancy-value theory created by Tolman and Levin that emphasizes on the assumption about people can be motivated to participate in activity if it is valued and links to satisfaction, (2) the theory of Self-efficacy developed by Bandura refers to the belief of self-capacities to reach the goal, and (3) Self-esteem theory of Carl Roger that focuses on a function of how a person matches self-ideals with the abilities of problem-solving and decision making [12]. As the result of this combination, ARCS model, therefore, composes of four steps, namely, Attention, Relevance, Confidence, and Satisfaction [13]. By using ARCS model, pre-service teachers tend to see value and importance of developing information retrieval skills and successfully move to the highest level in order to fulfill their learning satisfaction [14].

B. Skills Measurement

Kraiger et al. (1993 cited in [15]) has divided skills into three distinguish levels: initial skill, compilation skill, and automaticity. In addition, Carpenter [15] suggested that each skill need different measuring approaches. Self-rating and observer-rating are used to measure initial skill. Communication skill or compilation skill can be measured by using the approaches of competency evaluation form and self-assessment. Automaticity skill is measured through the approaches of observation and interview.

Wong and Lem (2005 cited in [15]) developed self-rating measuring form that allows the participants to measure their knowledge, skills, and attitude. This self-rating form was approved as internal reliability that each item in the form

significantly relates to one another, and participants' conditional reliability.

This present research; therefore, choose to use self-report-questionnaire with four rating scales and in-depth interview to collect data on critical information retrieval skills of pre-service teachers.

C. Information Retrieval Skills

Information retrieval skills include: accessing information effectively, evaluating information critically, and using information accurately and creatively. Respectively, an individual who possess information retrieval skills tends to be able to determine the extent of information required, access the needed information effectively and efficiently, evaluate information and its sources critically, incorporate chosen information prior knowledge, apply information effectively to accomplish a specific purpose, and understand the way to use and access information as well as use information ethically and legally [16]. In emphasizing on the context of education, Andretta (2005 cited in [16]) indicated that as the result of the increasing volume of information available, teachers are encountered with diverse, abundant information choices, hence, information retrieval skills are viewed as an one of the most important competencies for teachers and it is regarded as the basis of lifelong learning that is the key characteristic of professional teachers. Thus, this study focused on developing information retrieval skills of pre-service teachers as the way to enhance professional teacher development for the future teachers.

D. Conceptual Framework

Zone of Proximal Development (ZPD) and ARCS were used to analyze and interpret data in order to find out critical information retrieval skill development of the pre-service teachers (see Fig. 1).

First, Actual Development of the pre-service teachers will be examined through the use of questionnaire. Then, in-depth interview was used to collect the data on conditions of critical information retrieval skill of the pre-service teachers.

Next, learning activity applied the model of ARCS to boost the pre-service teachers to the possible level of development. Next, the results of the pre-service teachers' practices (information selection, filter, and relevant evaluation) relate to information retrieval skill were analyzed in order to find out Potential Development Level.

Finally, the approaches of in-depth interview and focus group were taken in order to evaluate learning satisfaction.
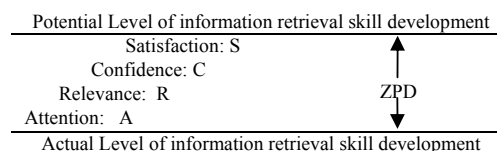
Potential Level of information retrieval skill development

Satisfaction: S
Confidence: C
Relevance: R   ZPD
Attention: A

Actual Level of information retrieval skill development

Fig. 1 Conceptual framework

IV. METHODOLOGY

A. Research Cohort

Forty-one senior mathematics pre-service teachers were purposively selected. The cohort has been studying in the Faculty of Education, Suan Sunandha Rajabhat University of Thailand in second semester of 2013.

B. Research Tools

Each research cohort was required to answer the questionnaires, which is used to measure their information retrieval skills. The questionnaire was approved as content validity and reliability (IOC=0.66, α=0.834).

C. Data Collection

1. Questionnaire and in-depth interview were used to collect data before the use of ARCS learning activities;
2. Learning activities require 6-7 learning hours (see Table I) and were use as the way to develop critical information retrieval skills of the mathematics pre-service teachers as well as to identify weakness and strength of critical information retrieval skills.

TABLE I
COMPONENT OF ARCS MODEL IN LEARNING ACTIVITY

Strategy	Learning Activity
Attention: A	Arousing learning interest and realization, using variety of learning resources such as video clips, story-telling
Relevance: R	Orientating goal and expectation, informing measurement and evaluation criteria
Confidence: C	Grouping learners into 4-5 people per group and engaging learning in cooperative learning, presentation, being criticized on strength and weakness by the instructor and instructor providing suggestions, and providing reinforcement
Satisfaction: S	Measuring learning satisfaction of the learners, and concept comprehension, sharing opinion and attitudes toward learning activities, and interviewing each group of the learners, and using focus group approach

3. Finally, data were summarized and interpreted into comprehensible results. Achievement level rating scale was used to describe the success that the mathematics pre-service teachers have achieved. The achievement scale score composes of 6 levels ranging from "extremely high", "very high", "high", "moderate", "low", and "very low". (see Table II)

TABLE II
ACHIEVEMENT LEVEL RATING SCALE

Mean	Level	Mean	Level	Mean	Level
3.51– 4.00	extremely high	2.51–3.00	high	1.51 – 2.00	low
3.01– 3.50	very high	2.01–2.50	moderate	1.00 – 1.50	very low

V. RESULTS

1. Before using learning activities applied ARCS model, the researcher investigated conditions of information retrieval skills of mathematics pre-service teachers and found that overall the pre-service teachers had already acquired high level of information retrieval skills (see Table III).

TABLE III
RESULTS OF INFORMATION RETRIEVAL SKILLS LEVEL OF MATHEMATICS PRE-SERVICE TEACHER

Items	A	U	S	N	μ	σ	Skill Level
1. I can identify main idea, supporting detail, and conflicts of the information.	3	3	15	-	2.29	.60	moderate
2. I always set questions as the framework when searching information.	4	10	27	-	2.44	.67	moderate
3. I use information ethically and legally.	5	13	20	3	2.49	.81	moderate
4. I always choose up-to-date information.	5	29	7	-	2.95	.54	high
5. Studying and sharing information with peers can lead me toward a better and clearer understanding.	6	20	14	-	2.80	.69	high
6. I always make reference list and in-text-citation.	2	11	21	7	2.80	.78	high
7. I always take the concept of learning content into consideration, when searching information.	3	27	11	-	2.80	.56	high
8. I always evaluate reliability of the information.	6	21	13	1	2.78	.72	high
9. I always evaluate and choose relevant and appropriate information.	5	19	17	-	2.71	.68	high
10. I always share and exchange information with friends and instructors.	4	18	19	-	2.63	.66	high
11. I always think critically about different dimensions, when searching information.	1	22	18	-	2.59	.55	high
12. I always search and gather information from different sources before summarizing.	4	15	22	-	2.56	.67	high
13. I always extract and select most accurate and relevant information from websites.	18	19	4	-	3.34	.66	very high
14. I always filter information that I found.	10	24	7	-	3.07	.65	very high
15. I always choose the most appropriate information.	9	25	7	-	3.05	.63	very high
Total					2.74	.43	high

Note: A = always U = usually S = sometimes N = never μ = mean σ = standard deviation

In conducting in-depth-interview and focus group as the approach to assure the accurateness of the data collected from questionnaire, it discovered that the mathematics pre-service teachers has completely passed the course of Mathematics for Research Study. Respectively, it can describe that the pre-service teachers experienced basic research process that including of information retrieval methods. Therefore, this experience tends to influence level of information retrieval skills. The researcher additionally found that although the pre-service teachers experienced retrieving information, they are not necessarily effective information retrievers. This is because the investigation revealed that each group of pre-service teachers retrieved information from websites such as Google without the processes of critical evaluation, filter, and accurate information selection. According to the results from the investigation, the researcher concluded that mathematics pre-service teachers lacked effective critical information retrieval skills.

2. After using learning activities applied ARCS model, the researcher found that overall information retrieval skills of mathematics pre-service teachers were at high level (overall μ = 3.11, and σ = 0.45, each item 2.75 < μ < 3.42 and 0.56 < σ < 0.78). In addition, there are four items in the questionnaire that appeared to gain high level as shown in the Table IV.

TABLE IV
ITEMS IN THE QUESTIONNAIRE GAINING HIGH LEVEL OF INFORMATION RETRIEVAL SKILLS

Items	μ	σ
I can identify main idea, supporting detail, and conflicts of the information.	2.76	0.73
I always set questions as the framework when searching information	2.85	0.76
I always share and exchange information with friends and instructors.	2.88	0.71
I always think critically about different dimensions, when searching information.	2.98	0.69

3. With using learning activities applied ARCS, mathematics pre-service teachers agreed that they gained more knowledge and understanding concerning the process of conducting research as well as the process of information retrieval. Moreover, they revealed that with knowledge of information retrieval, they could also develop their critical thinking skill. This is because to reach effective information retrieval skills development, the pre-service teachers need to develop the skills of assessing information effectively, evaluating information critically, and effective. All of these skills appeared to influence their critical thinking skill. Therefore, the pre-service teachers tended to develop information retrieval skills critically (see Table V).

Lastly, mathematics pre-service teachers' satisfaction is at high to very high level. Therefore, it can summarize that learning activities applied ARCS model can effectively develop information retrieval skills of the pre-service teachers.

TABLE V
DATA SHOWING DIFFERENCES BETWEEN, BEFORE AND AFTER USING LEARNING ACTIVITIES APPLIED ARCS MODEL

Before using learning activities applied ARCS model	After using learning activities applied ARCS model		
1. Most information was retrieved from websites and lacked references.	1. Mathematics pre-service teachers retrieved information from various sources such as textbooks, besides, and books. They additionally selected only up-to-date information that is not over than 3-5 years, and retrieved from academic articles with peer reviewed.		
2. Information appeared to be inadequate for conclusion, analysis, and synthesis.	2. The pre-service teachers analyzed information by using comparison methods in order to evaluate quality of the information.		
	Source	Similarity	Difference
3. The pre-service teachers did not retrieve information from international or English source because of their limitation of English reading skill.	3. The pre-service teachers considered that English reading skills and translation skills are important skills that help to acquire international information.		
4. The pre-service teachers used the approach of trial and error to retrieve information from Google rather than setting framework for information retrieval.	4. The pre-service teachers viewed that setting framework and planning searching strategy are important as they can help to obtain relevant and accurate information.		

V. CONCLUSION AND DISCUSSION

1. According to the research findings, the data collected before applied ARCS learning activities revealed that mathematics pre-service teachers had acquired inadequate critical information retrieval skills in terms of concept and process. Therefore, this is implication for the Faculty of Education to develop critical information retrieval skills of the pre-service teachers from the first year of teacher preparation program, and then they tend to develop their skills to the highest level or professional level. Moreover, the Faculty of Education should launch curriculum that supports the integration of information retrieval knowledge in subject matter of all subjects and learning activity such as project-bases learning, problem-based learning, and information searching-based. Additionally, Bandura (1993 cited in [17]) supported the points by indicating that in order to engage learners in retentive knowledge; it is needed to start from the beginning of their learning.

2. By using learning activities applied ARCS model, 90.24 percent of the mathematics pre-service teachers developed their information retrieval skills to meet expected level. In the other words, the pre-service teachers realized the importance of information retrieval skills, therefore, they established needs and behavior that led them to develop the critical information retrieval skills including of effectively accessing various information resource such as accurate websites, online e-journals, academic journals, and textbooks, evaluating information critically, and using information accurately and creatively. Finding of the current research is in line with the discovery of Huett et

al. [12] that found ARCS model is an effective approach of improving and developing learning achievement of learners.

3. The research finding on learning satisfaction supported Keller [13] who discovered that learning satisfaction could influence learning achievement of learners to meet the expectation of learning. In this current research, mathematics pre-service teachers expressed high to very high level learning satisfaction. In the other words, the-pre-service teachers were satisfied with participating in learning activities applied ARCS model.

VI. RECOMMENDATIONS

1. Adequate period of time is one of the most important factors affecting and influencing level of development. In addition, characteristic of the instructors also takes part in development level of learners because if learners are satisfied with learning by the instructors, they tend to be motivated to learn and develop effectively. Therefore, it is necessarily for the instructors to adjust teaching style to match and serve the nature and needs of the learners.

2. The Faculty of Education should establish "Resource Centers" as the approach of reinforcing critical information retrieval skills and knowledge of the pre-service teachers.

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Suttipong Boonphadung was born in Bangkok, Thailand on July 3rd, 1968. In 1990, he obtained his first degree of Bachelor of Education (Honors) from Suan Sunandha Teacher College, Bangkok, Thailand. Then in 1997, he furthered his studies in Educational Measurement (M.Ed) at Srinakharinwirot University in Bangkok, Thailand. In 2006, he graduated Doctorate in Curriculum and Instruction from Kasetsart University.

Today, he is a lecturer in Curriculum Design and Instructional Theory, Applied Mathematics, Mathematical Modelling, and Research for Learning Development at Suan Sunandha Rajabhat University, Bangkok, Thailand. Since 2008, he is also the Head of the Department of Master of Education Program in Curriculum and Instruction at Suan Sunandha Rajabhat University. Main research topics concern the principle of educational measurement and evaluation, the development of learning management, teaching for thinking skill enhancement, the development classroom action research for pre-service and in-service teachers. Recent studies include Sustainable Development of the Life Quality for the Elderly by Applying Sufficiency Economy-Based Schooling (South Korea, Jeju Island: Education and Management Technology, 2012), Life Long Education: Professional Development Guideline for Partnership in Practicum Placement of English Teacher Candidates in Suan Sunandha Rajabhat University (South Korea, Jeju Island: Education and Management Technology, 2012), and The Effects of Cooperative Groups as Communicative Language Teaching Techniques for Teaching Grammar to English Teacher Candidates in a Rajabhat University (South Korea, Jeju Island: Education and Management Technology, 2012) Developing Student Teachers To Be Professional Teachers (World Academy of Science, Engineering and Technology 73, WASET Switzerland 2013), and Voice in Pre-service Teacher Development (World Academy of Science, Engineering and Technology 73, WASET Switzerland 2013).