Social Science Asia, Volume 7 Number 2, p: 42-51

EFFECTS OF RESEARCH-BASED LEARNING INTEGRATED WITH COGNITIVE TRAINING FOR ENHANCING RESEARCH CHARACTERISTICS IN PHAYAMENGRAI SCHOOL

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Abstract

This research aims to compare grade 9 students' research characteristics implemented a learning model of research-based learning integrated with cognitive training and a regular learning model as research skills, research behaviors, and research ethics. The research employed a randomized two-group pretest-posttest design with 95 of grade 9 students, first semester, the academic year of 2019, Phayamengrai School, Phaya Mengrai District, Chiang Rai. The cluster random sampling was used to divide the population into two groups; 32 students were an experimental group, and 30 students were a control group. Research tools were two teaching models; a learning model of research-based learning integrated with cognitive training and a 5E learning model. Research data collection tools were a research characteristics self-assessment, a research skill test, and a research ethics assessment. The data analysis uses One Way MANOVA. The findings were that the developed model is more effective than the regular model in enhancing research characteristics. On the other hand, the experimental group had a higher average score on research behaviors, research skills, and research ethics than the control group.

Keywords: Research-based Learning, Cognitive training, Research characteristics

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Received: 15/08/63 ; Revised: 08/12/63 ; Accepted: 05/1/64

Introduction

In the 21st century, learners should possess sets of research characteristics as research skills, research behaviors, and research ethics to promote life-long learning. Therefore, they would gather the body of knowledge effectively by applying their research characteristics (Madens, Depaepe, Janssen, Raes, and Elen, 2020). Moreover, they would become learning persons and enhance their abilities as problem-solving, inquiry skills, basic research conducting, thinking skills, working skills, and critical thinking (Srikoon, Bunterm, Samranjai, Wattanathorn, 2014).

It was recently found that leaners still need guidelines in helping them consider and evaluate in various circumstances. Further, they tend to make the wrong decisions (Fisher et al., 2014). Additionally, learners are unable to conduct scientific experiments effectively as formulating a hypothesis and proper variables, searching for related information, setting research design, having inaccurate interpretation regarding graph, research problem, findings (Madens, Depaepe, Janssen, Raes, and Elen, 2020) also research ethics was misused (Srikoon, 2017). Therefore, learners should be enhanced research characteristics immediately. More importantly, grade 9 students, 14-15 years, are in crucial development milestones. Schools could help to level up their potentials. Phayamengrai School is one of many schools that foresees this array and prepares to help students to achieve their goals.

Srikoon, Bunterm, Nethanomsak, and Ngang (2018) developed a teaching model that integrated research-based and educational neurosciences, and its findings were that this model was effective in enhancing research characteristics; for example, research skills, research behaviors, and research ethics. However, Srikoon, Bunterm, Samranjai, and Wattanathorn (2014) found that the body knowledge of research-based Learning needed to keep updating, and the research-based Learning tended to lower learners' attitudes. Consequently, research-based learning should be continually developing, implementing, and updating.

Educational neurosciences have become widely used in the education field in cognitive ability (Srikoon, 2019a). Moreover, cognitive training or brain training becomes another aspect of learning theory that people have to train fluid intelligence or "Gf." Fluid intelligence is a part of cognitive ability, for example, working memory and inhibitory control, and the Gf corporates with many routine activities. Wiest, Wong, Bacon, Rosales, and Wiest (2020) stated that cognitive training could positively enhance working memory and academic skills. Fu, Kessels, and Maes (2020) also said that cognitive training could better Executive function.

Additionally, both working memory and Executive function positively affect routine performance. Furthermore, cognitive ability has been integrated into many teaching models. For example, Sanit (in press a) developed a teaching model to enhance working memory, Sanit (in press b) developed a teaching model integrating educational neuroscience to better learners' math achievement, and Apaivatin, Srikoon, and Khemkhan (in press) integrated research-based learning and cognitive training to better critical thinking skills. Also, Srikoon (2019b) implemented a teaching model that integrated research-based Learning and educational neurosciences in math subjects and found that the teaching model helped enhance math achievement. Then, cognitive training should be integrated with teaching models to update the body of education knowledge as Apaivatin, Srikoon, and Khemkhan (in press) developed a teaching model that integrated

research-based learning with cognitive training to be an alternative teaching innovation.

5E teaching model is to have learners perform five learning steps: Engagement, Exploration, Explanation, Elaboration, and Evaluation. The 5E model becomes a standard teaching model used in schools, and it is encouraged by The Institute for the Promotion of Teaching Science and Technology (IPST) (Srikoon, 2017). Notably, this research aims to distinguish research characteristics of the developed teaching model and the 5E teaching model to become prototype, guidelines, the body of knowledge for further studies.

Conceptual framework

Srikoon, Bunterm, Nethanomsak, and Ngang (2018) summarized that research characteristics consist of research skills, research behaviors, and research Cognitive Training. The researcher adapted cognitive training concept based on educational neuroscience as applying theories, concepts, principles, and research in educational neuroscience to develop the teaching model. ethics. Research skills refer to skills that one performs in conducting research, for instance, questioning, searching for information, planning research, collecting data, processing data, summarizing, and presenting. Research behaviors refers to manners that one performs as questioning, searching for information, planning research, collecting data, processing data, summarizing, and presenting. Research ethics refers to ethics that one demonstrates in questioning, searching for information, planning research, collecting data, processing data, summarizing, and presenting.

The research-based Learning integrated with the cognitive training teaching model consists of 2 learning concepts as follows:

1) Research-based Learning Teaching Model. This refers to the model that can enhance research characteristics as they are essential for 21st-

The details of the research-based learning integrated with a cognitive training teaching model (Srikoon, Khemkhan and Apaivatin, in press) and the lesson plan are in the appendix.

Table 1. The integrated teaching method of Research-based Learning and Cognitive training

Research-based Learning teaching method	Cognitive training	The RBL integrating with cognitive training
1) Identifying the research problem: to practice observing skills, questioning, analyzing problems, and identifying the actual problems	- Checking the students' prior knowledge. (Attention) - Looking at pictures or video clips relating to the lesson. (Attention and mood) - Writing the cause and effect diagram (Working memory)	Teacher checks students' prior knowledge, then practices students observing, questioning, analyzing problems, and identifying the actual problems by letting students look at interesting pictures or video clips relating to the lesson and write the cause and effect diagram
2) Hypnotizing: to practice students learning the procedure of analyzing data, finding causes,	- Writing linking causes to predictions of solutions reasonably. (Working memory and science process skills)	Students analyze the data and figure out the solutions systematically and evidently and hypnotize correctly to write the causes

Research-based Learning teaching method	Cognitive training	The RBL integrating with cognitive training
predicting solutions systematically and evidently, and hypnotizing properly.		and the predictions of solutions reasonably.
3) Hypothesis testing: to practice students in investigating design procedure and examining the hypothesis suitably with the studying or research.	- Writing the research proposal or research plan and practicing ordering the priority. (Attention and working memory) - Cooperating by setting duty to every group member.	Students work in groups to help design the investigation, examine the accurate hypothesis relating to the study or research, write the research proposal or research plan, and practice planning and ordering the priority.
4) Data collecting: to practice students to search for the sources, collect data, and create the appropriate instruments.	- Learning by doing, all students do each task independently, and the teacher works as a facilitator and advisor. (Attention, working memory, and mood)	All students learn by doing, which is searching and collecting data and creating the instruments appropriately. A teacher works as a facilitator and advisor.
5) Analysing data: to practice students analyzing the collected data, using various statistical means to evaluate and present analyzed data.	- Using internalization to help students think about the difficult and complicated aspects of analytical and critical thinking. (Attention and working memory)	Students analyze the collected data using internalization to analyze the collected data, not plagiarize systematically and use basic statistics. Besides, they manage to evaluate and present the analyzed data.
6) Concluding: to practice students summarising the research to answer the hypothesis and writing the advised research conclusion.	- Writing the concept map to enhance students' conclusions and create an understandable presentation. (Attention and working memory) - Discussing and sharing ideas among teachers and students. (Mood)	Students can summarise the results of the research by using a concept map making the presentation understandable. Moreover, the teacher and students discuss and share ideas regarding the originating knowledge and experiences by doing the activity together.

The researcher summarized a conceptual framework, as in figure 1.

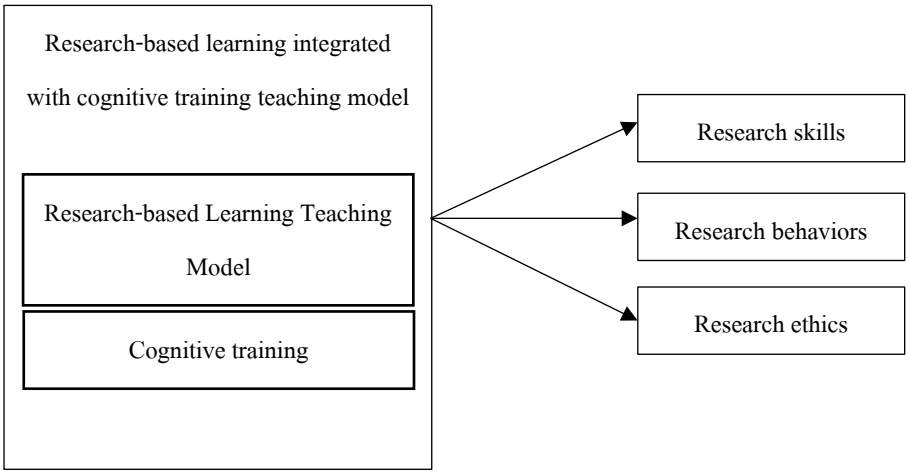

Figure 1 Conceptual framework

Figure 1 illustrates that this developed model included the independent and dependent variable in research skills, research behaviors, and research ethics.

Research objectives

To compare research characteristics concerning research skills, research behaviors, and research ethics of grade 9 students by implementing the research- based learning integrated with cognitive training teaching model and the 5E teaching model.

Research methodology

The research design was the randomized two-group pretest-posttest design, and the methodology is as follows:

1. Population and target groups

1.1 Research population

Ninety- five of grade 9 students, first semester, the academic year of 2019, Phayamengrai School, Phaya Mengrai District, Chiang Rai.

1.2 Target groups

The cluster random sampling was used to divide the population into two groups; 32 students were an experimental group, and 30 students were a control group. There were more than 30 students in each group, which can be a representative sample of the population (Srikoon, Bunterm, Nethanomsak, and Ngang, 2018)

2. Research variables

2.1 Independent variables

There were two teaching models; a learning model of research- based Learning integrated with cognitive training and a 5E learning model.

2.2 Dependent variables

There were research characteristics concerning research skills, research behaviors, and research ethics.

a. Teaching Content

The content was the foundation of Science for grade 9 students, Earth science and space concerning the universe, and both groups were taught the same content. It covered 12 teaching hours.

b. Research duration

The duration was six weeks, from May to October 2019.

c. Research tools

i. Research tools were two teaching models; a learning model of research-based Learning integrated with cognitive training and a 5E learning model. The researcher created 8 lesson plans for 12 hours, according to Earth science and space content. Moreover, those lesson plans were approved by three experts.

ii. Research data collection tools were a research behaviors self-assessment, a research skill test, and a research ethics assessment verified regarding validity and reliability, as in table 2. This research has approved by the University of Phayao, Human Ethics Committee.

Table 2 Data collection tools

No.	Variables	Tools	Tool's feature	Validity	Reliability and others
1	Research behaviors (Srikoon, Bunterm, Nethanomsak, Ngang 2016)	a research behaviors self-assessment	Rating scale	construct validity checked	Cronbach Alpha coefficient was 0.979
2	Research skills (Srikoon, Bunterm, Nethanomsak and NgangTang , 2018)	a research skills test	Multiple choices: 4 choices	(1) ICO was between 0.714 – 1.000 (2) construct validity checked	(1) The difficulty was between 0.333 – 0.733 (2) Discrimination was between 0.226 – 0.636 (3) KR – 20 was 0.774
3	Research ethics (Srikoon, 2017)	a research ethics assessment	Checklist	(1) IOC was between 0.571 – 1.000 (2) construct validity checked	Cronbach Alpha coefficient was 0.893

Data analysis

One Way MANOVA was employed to analyze the data.

Research findinge

1. Statistics of the average score on research characteristics of the control and experimental group

1. 1 Statistics of the average score on research characteristics of the control group

Table 3 Statistics of the average score on research characteristics of the control group

Variables	Statistics						
	$\bar{x}$	S.D.	CV(%)	MIN	MAX	SK	KU
Research skills - Pretest	11.267	1.837	3.375	8.00	15.00	0.150	-0.539
Research skill – Posttest	14.667	1.918	3.678	11.00	18.0	0.229	-0.513
Research behaviors – Pretest	1.002	9.293	86.350	84.00	117.00	-0.089	-1.055

Variables	Statistics						
	$\bar{x}$	S.D.	CV(%)	MIN	MAX	SK	KU
Research behaviors– Posttest	1.149	4.559	20.783	102.00	125.00	-0.146	1.606
Research ethics – Pretest	14.600	2.836	8.041	10.00	19.00	0.145	-1.062
Research ethics – Posttest	19.467	1.042	1.085	18.00	21.00	0.095	-1.102

Table 3 shows that the control group's post-test average score was higher than the pretest in all three aspects.

1.2 Statistics of the average score on research characteristics of the experimental group

Table 4 Statistics of the average score on research characteristics of the experimental group

Variables	Statistics						
	$\bar{x}$	S.D.	CV(%)	MIN	MAX	SK	KU
Research skills - Pretest	11.281	2.492	6.209	6.00	17.00	-0.036	0.040
Research skill – Posttest	17.719	2.715	7.370	11.00	24.00	-0.271	0.254
Research behaviors – Pretest	1.038	7.620	58.072	90.00	116.00	-0.189	-1.115
Research behaviors– Posttest	1.193	7.512	56.426	105.00	151.00	2.227	9.842
Research ethics – Pretest	14.813	2.235	4.996	11.00	19.00	-0.101	-0.843
Research ethics – Posttest	19.938	1.294	1.673	17.00	21.00	-1.022	-0.014

Table 4 illustrates that the experimental group's post-test average score was higher than the pretest in all three aspects.

2. Findings on the average score of research characteristics using One Way MANOVA

Table 5 Findings on the average score of research characteristics using One Way MANOVA

Teaching model	Stat	Value	F	Hypothesis df	Error df	Sig.
Teaching model	Pillai's Trace	0.394	5.950	6	55	0.000
	Wilks' Lambda	0.606	5.950	6	55	0.000
	Hotelling's Trace	0.649	5.950	6	55	0.000
	Roy's Largest Root	0.649	5.95	6	55	0.000
Box's M=42.328, F=1.799, Sig=0.014						

Table 5 shows the finding of Box' s Test of Equality of Covariance Matrices as the Sig. = 0.014 was higher than the fix significance (0.05). It implies that the variance-covariance matrix of the population was different. Then, the researcher employed Multivariate Tests and chose Pillai's Trace since this statistic has robustness. It was found that the F value was 5.950, Sig. was 0.000, which was lower than the fix significance (0.05). This implies that the developed model is useful in teaching learners regarding research characteristics concerning research skills, research behaviors, and research ethics.

Discussion and suggestion

1. Discussion

The findings show that the developed model was more effective than the regular model. The model combined cognitive training to enhance intention, emotion, and working memory. The steps are as follows; step 1 learners identify research problems, review prior knowledge using pictures, videos, and fishbone map; step 2 learners write cause and effect; step 3 learners prove a hypothesis by planning and prioritizing; step 4 learners collect data; step 5 learners analyze data by using mind mapping; and step 6 learners summarize and create concept maps (Srikoon, Khemkhan and Apaivatin, in press). Besides, each step integrated research-based Learning and cognitive training. Thus, it could enhance learner' s research characteristics. This relates to Srikoon, Bunterm, Nethanomsak and Ngang (2018) as they developed a teaching model integrating research-based and cognitive training and found that the model was effective in enhancing research characteristics. Further, the model included emotion training activities with pictures or videos, group work, and discussion. Therefore, further studies should include emotional aspect or intention and working memory as also Srikoon, Bunterm, Nethanomsak, and Ngang (2017) stated that a research-based integrated with neuroscience teaching model was useful in enhancing intention, working memory, and emotion. Consequently, the research- based integrated with the cognitive training teaching model is effective in enhancing research characteristics.

2. Recommendation

2.1 Recommendation for the research implement

1. It is recommended that teachers should study the teaching model carefully to implement the model in class effectively.

2. It is recommended that teachers should carefully design learning activities to fit with the model's learning steps.

2.2 Recommendation for further studies

1. It is recommended that further research should implement other variables; critical thinking, problem-solving skills, and creative thinking.

2. It is recommended that further research should conduct a comparative study between the developed model and other teaching models; problem- based learning, project- based learning, and STEM model.

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