JPPS (Jurnal Penelitian Pendidikan Sains)
p-ISSN: 2089-1776
e-ISSN: 2549-1597
Volume 8, No. 2, Mei 2019
https://journal.unesa.ac.id/index.php/jpps/index

THE EFFECTIVENESS OF MCTS LEARNING MODEL TO IMPROVE CRITICAL THINKING SKILLS AND DISPOSITION

F Farcis[1], Suyatno[2], and W Widodo[3]
[1]Departement of Physics Education, Faculty of Teacher Training of Education
Palangka Raya University, Indonesia
[2]Departement of Chemistry, Faculty of Mathematics and Natural Science,
State University of Surabaya, Indonesia
[3]Departement of Science Education, Faculty of Mathematics and Natural Science,
State University of Surabaya, Indonesia

Abstract. MCTS learning model (Making Critical Thinking Students) is a learning model that refers to self regulated learning and uses ICT as a learning media. The purposes of this study was to analyze the effectiveness of the MCTS model to improving the critical thinking skills and disposition of students. This research was carried out to physics education students of Palangka Raya University who was attended the research methodology lecture. The effectiveness of the MCTS learning model is based on (1) the results of critical thinking skills and disposition of students and (2) students respons to the model. The results of the study show that critical thinking skills of physics education students at Palangka Raya University have increased significantly, with $\alpha = 5\%$, N-gain average critical thinking skills are consistently at very high criteria. Critical thinking disposition of learning a significant increase in positive criteria. Physics education students at Palangka Raya University averaged 95.33% giving a positive respons to MCTS learning model and its devices. Conclusion based on the results of the study of the effectiveness of the MCTS learning model is effective applied in learning to improve the critical thinking skills and disposition of physics education students of Palangka Raya University as a candidate physics teachers.

Keywords: *effectiveness of MCTS model, critical thinking skills, critical thinking disposition*

INTRODUCTION

Teachers are the main factor in the education process and are one of the main movers in the progress and development of the world of education. Fullan (2001) states that, changes in the educational paradigm depend on the actions and ways of thinking of educators. Rienties, Brouwer, & Lygo-Baker (2013) and Avalos (2011) argue that the existence of quality educators is an absolute requirement for the presence of quality and professional education systems and practices.

Professional teachers must have 21st century educator skills which include critical thinking, creative skills, problem solving, self-management, Information and Communication Technology (ICT), communication and collaboration (OECD, 2008). The results of several studies note that educators need support to develop their professional behavior (Snoek, Swennen, & Van der Klink, 2011; Sahlberg, 2010; Swennen, Jones, & Volman, 2010; Darling Hammond & Richardson, 2009; Koster, Brekelmans, Korthagen , & Wubbels, 2005).

21st century professional physics teachers are very much needed at this time considering physics is one of the basic sciences which is the foundation in individual thinking patterns to be developed as the main supporters in problem solving, especially with the application of practical science (Sunaryo, 2011). Mastery of physics (science) material requires basic thinking skills (Novak & Gowin, 1985) and also complex thinking skills (high), including critical thinking (Costa & Pressceincen, 1985).

Critical thinking can be categorized into 2 parts, namely critical thinking skills and critical thinking disposition. Skills can be measured according to existing indicators, while dispositions tend to be determined according to their sub-scales. Facione (2015) argues that critical thinking is basically a detailed description of several characteristics which include the process of interpretation, analysis, evaluation, inference, explanation, and self regulation. There are several things that are common characteristics of critical thinking, including being able to make and evaluate conclusions by examining problems, evidence, and solutions logically and systematically (Woolfolk, 2009).

Facione, Giancarlo, Facione, & Gainen (1995) suggest that there is a set of character attributes that are considered to be related to the development of the success of critical thinking skills, namely critical thinking disposition. Disposition thinking is a tendency towards certain patterns of intellectual behavior (Facione, Giancarlo, Facione, & Gainen, 1995). Disposition to critical thinking consists of: truth seeking, open-mindedness, analysis, systematicity, self-confidence, curiosity, and maturity in truth-seeking, open-mindedness, confidence in reasoning, analyticity, systematicity, inquisitiveness, and maturity in judgment.

There are several things that are common characteristics of critical thinking, including being able to make and evaluate conclusions by examining problems, evidence, and solutions logically and systematically (Woolfolk, 2009). Beachboard & Beachboard (2010) conducted a study of critical thinking pedagogy and student perceptions. Students recognize that the effort to involve students in high-level thinking activities is a contribution to the development of their critical thinking skills. Educators must have quality in critical thinking for the development of education in higher education (Ijaiya, Alabi, & Fasasi, 2011). Developing problem solving skills and developing argumentation skills from an early age is a superior strategy in improving critical thinking skills (Manali, 2016). Phan (2010) from the results of his research concluded that critical thinking actions as other strategies of cognitive self-regulation of students used in their learning, and critical thinking can be the product of various things that precede, as well as different self-regulation strategies.

Critical thinking skills can be developed through the processing of habitual thinking analysis and strategic thinking. There is a positive relationship between critical thinking skills and critical thinking disposition. However, further analysis shows that only students who have high critical thinking skills and moderate critical thinking dispositions that show significant correlations (Yang & Chou, 2008); increasing critical thinking disposition is reinforced by critical thinking skills, but improvement in critical thinking disposition does not increase the level of critical thinking skills. Miri, David, & Uri (2007) found that there were significant differences in the results of skills and critical thinking disposition of the experimental group (groups that were treated (taught) with learning strategies to improve critical thinking skills) and control groups (groups not given treatment)) Skills and critical thinking dispositions must be planned from the start to be provided for students in the learning process or in other words deliberately want to be provided to students. Three strategies can be used to increase high order thinking students, which involve students

with real case examples, open-ended discussions, and experiment oriented inquiry.

21st century professional physics teachers, in addition to having skills competencies and critical thinking disposition must also be equipped with Information and Communication Technology (ICT) skills. Over the past two decades, computerized technology and internet resources have been used for teaching, learning and teaching and learning (Miri & Dori, 2009). MaKinster, Barab, & Keating (2001) state that much effort has been made in designing and implementing academic programs for the professional development of teachers using online communication and fostering change in practice in the field. This is supported by the opinion of Rahman, Setiawan, & Fitrajaya (2008) which states that learning by utilizing or integrating ICT can facilitate teachers and students because it provides opportunities for students to learn dynamically and interactively. In addition, ICT utilization makes it easy for students to look for teaching materials (Savittree, Padilla, & Tunhikorn, 2008) and also learning that utilizes ICT can optimally improve student learning achievement (Chandra & Loyd, 2008).

Indonesia prepares teachers candidates in an institution, namely the LPTK (Institute of Educators and Education Personnel) in each province and several districts in Indonesia. LPTK has a strategic role in improving the quality of prospective educators through improving students' thinking skills. Learning in a course that seeks to improve skills and critical thinking dispositions of students as potential physics educators integrated with ICT skills and collaborative skills must get the attention of educators at LPTK because the overall skills that must be trained are the provision of 21st century professional physics educators in completing academic tasks and everyday social problems. One of the courses that must be taken by physics education students before preparing the final assignment is the research methodology course.

The results of the study of cooperative learning literature, blended learning and journal club learning reinforce that the three learning models have strengths and weaknesses that can be considered in the development of learning models that aim to improve critical thinking skills and disposition thus developing a learning model based on parameters of critical thinking skills and disposition with ICT media that are supported by learning syntax which consists of: 1) delivery of objectives and problem orientation, 2) face-to-face journal surgery, 3) online journal surgery, 4) discussion and reflection, and 5) evaluation. This learning model is named according to the purpose of the model in learning, namely the MCTS model (Making Critical Thinking Students).

METHOD

This research was conducted at University of Palangka Raya (Palangka Raya, Indonesia). The research subjects were physics education students who took the research methodology class in the 2018/2019 academic year. The purpose of this study was to analyze the effectiveness of the MCTS learning model in learning research methodology in an effort to improve the skills and dispositions of critical thinking students of physics teacher candidates. The effectiveness of the MCTS learning model is based on (1) the results of learning skills and critical thinking disposition and (2) student respons to the MCTS learning model.

Data Collection Technique

This research was conducted using a one-group pretest-posttest design, namely one group of students subjected to treatment and the dependent variable was observed and measured to assess the effect of the treatment (Fraenkel & Wallen, 2012). The treatment in question is learning research methodology by applying the MCTS learning model. The dependent variable measured is critical thinking skills and dispositions. The one-group pretest-posttest design diagram is shown below this.

O_1	***X***	***O_2***
Pretest	***Treatment***	***Posttest***

X = Learning with the MCTS model
O_1 = Critical Thinking Skills and Critical Thinking Disposition Pretest
O_1 = Critical Thinking Skills and Critical Thinking Disposition Posttest

Table 1. Research Instrument

O_1 ***(Pretest)***	***X*** **(Model *MCTS*)**	***O_2*** ***(Posttest)***
Assessment of Critical Thinking Skills *Self Rating Critical Thinking Disposition*		Assessment of Critical Thinking Skills *Self Rating Critical Thinking Disposition*. Student Respons Questionnaire

Data Analysis Technique

Data collection techniques must be appropriate and in accordance with the research objectives to obtain research data that is relevant, accurate, and usable. Data collection in this study uses the following techniques:

1. Evaluation Technique
   a. Data on students' critical thinking skills are obtained through tests, namely Critical Thinking Skills Assessment (PKBK) conducted at the beginning and end of learning. Indicators of critical thinking skills include: interpreting, analyzing, evaluating, inference, explanation, and self regulation about an object of problem (Facione, 2015).The assessment of critical thinking skills (PKBK) given is in the form of essays that have answers with definite formulas, so scoring can be done objectively. PKBK is prepared based on the learning outcomes of the research methodology courses to be achieved. Critical thinking skills are analyzed based on scores obtained by students before and after learning using the MCTS model. Levels of scores for critical thinking skills are based on indicators of interpretation, analysis, evaluation, inference, explanation, and self regulation (Facione, 2015). PKBK was analyzed based on critical thinking rubrics. The critical thinking rubric used in this study is in the form of a multilevel scale, which is a statement followed by columns that show the levels of scoring with a scale of scoring in accordance with predetermined criteria. The data obtained in this study are quantitative data, namely data about the test scores of critical thinking skills analyzed descriptively using the following equation:

$$PKBK = \frac{The\ number\ of\ scores\ obtained}{The\ number\ of\ maximum\ scores} x\ 100\%$$

Criteria for critical thinking skills in this study are divided into 5 categories according to Slameto (2003), stated in Table 2.

Table 2. Criteria for Critical Thinking Skills

Score	Criteria
89% < x ≤ 100%	Very High
78% < x ≤ 89%	High
64% < x ≤ 78%	Moderate
55% < x ≤ 64%	Low
0% < x ≤ 55%	Very Low

(Slameto, 2003)

b. The data of student critical thinking disposition is obtained through tests, namely the Assessment of Critical Thinking Disposition (PDBK) in the form of self-assessment, namely self-rating of critical thinking disposition conducted at the beginning and end of learning. Indicators of critical thinking disposition include: truth-seeking, open-mindedness, systematically, analytically, self-confidence, inquisitiveness, and maturity in judgment (Facione, 2015).

Table 3 Critical Thinking Disposition Criteria

Score	Criteria
> 70	Positive
50 - 70	Ambivalent
< 50	Negative

(Facione, 2015)

Analysis of student critical thinking disposition assessment data was analyzed based on points for each in the self-rating critical thinking disposition questionnaire. Every answer "Always" on odd number questions and "Never" answers on even number questions gets point 5. Data about critical thinking disposition scores analyzed descriptively using criteria Table 3.

2. Questionnaire

Questionnaire was used to obtain data/ information about student responses to the implementation of the MCTS model in learning research methodology courses. Student responses were measured using student response questionnaire instruments. The effectiveness of the MCTS model can be seen from the scores of student responses after minimal learning in quite positive criteria (41% - 60%) (Arikunto, 2010).

Data obtained from questionnaires are displayed in table form, then the percentage of students who choose the option Strongly Disagree (STS) is sought; Agree (S); Disagree (TS); and Strongly Agree (SS) on each item. The percentage to determine each item is determined using the following formula.

$$P = \frac{M}{T} x\ 100\%$$

P = Percentage of student choices
M = Frequency of student choices
T = Total Student who filled out the questionnaire

The percentage of student responses is converted by the Arikunto (2010) criteria as follows.

Angka 0 % - 20% = Very Negative
Angka 21% - 40% = Negative
Angka 41% - 60% = Average
Angka 61% - 80% = Positive
Angka 81% - 100% = Very Positive

RESULT AND DISCUSSION

Value data from the analysis of critical thinking skills show details of value data and N-gain critical thinking skills for each individual. The data in Table 4 show that the critical thinking skills possessed by students before using the MCTS model are classified as low criteria. The implementation of the MCTS model has an impact on improving critical thinking skills. The data in Table 4 show that the critical thinking skills possessed by students before using the MCTS model are classified as low criteria. The implementation of the MCTS model has an impact on improving critical thinking skills.

Critical Thinking Skills

Details of value data and N-gain critical thinking skills for each individual shown in Table 4. The data in Table 4 showed that the critical thinking skills possessed by students before using the MCTS model are classified as low criteria. The implementation of the MCTS model has an impact on improving critical thinking skills. After using the MCTS model there is an increase in critical thinking skills of each individual which varies from moderate to very high criteria.

There are 6 (six) students who have criteria for improving critical thinking skills with very high criteria, namely M7, M11, M13, M16, M18, M19, and M20. A total of 9 (nine) students have criteria for improving critical thinking skills with High criteria. There are 4 (four) student has criteria for improving critical thinking skills with moderate criteria, namely M1, M10, M12, and M15. Classically, the increase in critical thinking skills in the course of research methodology is limited to 0.86 in high criteria.

Table 4 Score and N-gain Individual Critical Thinking Skills

Student Initial	Pretest		Posttest		Coef. N-gain	N-gain
	Score	Criteria	Score	Criteria		
M1	0,50	Low	2,33	Moderate	0,73	V. High
M2	0,67	Low	2,67	High	0,86	V. High
M3	0,50	Low	2,50	High	0,80	V. High
M4	0,67	Low	2,67	High	0,86	V. High
M5	0,33	Low	2,67	High	0,87	V. High
M6	0,33	Low	2,67	High	0,87	V. High
M7	0,50	Low	2,83	V. High	0,93	V. High
M8	0,33	Low	2,67	High	0,87	V. High
M9	0,33	Low	2,50	High	0,81	V. High
M10	0,33	Low	2,33	Moderate	0,75	Medium
M11	0,33	Low	2,83	V. High	0,94	V. High
M12	0,33	Low	2,00	Moderate	0,62	V. High
M13	0,50	Low	2,83	V. High	0,93	V. High
M14	0,50	Low	2,67	High	0,87	V. High
M15	0,17	Low	2,33	Moderate	0,76	V. High
M16	0,67	Low	3,00	V. High	1,00	V. High
M 17	0,17	Low	2,50	High	0,82	V. High
M18	0,50	Low	3,00	V. High	1,00	V. High
M19	0,17	Low	2,83	V. High	0,94	V. High
M20	0,17	Low	3,00	V. High	1,00	V. High
Average	**0,40**	**Low**	**2,64**	**V. High**	**0,86**	**V. High**

Table 5 reveals that in the broad test, the achievement of the prestest mean and posttest scores of students' critical thinking skills are in the high to very high category. The achievement of student scores in conducting inference is the lowest, namely 81.68 in the high category. The highest student achievement in interpreting is 95.00 in the very high category. These results reflect that students 'skills in

critical thinking must be further improved, but this result also shows that by practicing continuously for 6 (six) meetings and 12 (twelve) journal analysis activities, students' critical thinking skills can be maximally produced.

Table 5 Analysis of Pretest and Posttest Scores for Each Indicator of Critical Thinking Skills

No	Indicator	Score Pretest	Criteria	Score Posttest	Criteria	Coef. N-gain	N-gain
1	Interpretation	15,00	Low	95,00	V. High	0,94	High
2	Analysis	18,34	Low	85,02	High	0,82	High
3	Evaluation	13,34	Low	91,69	V. High	0,90	High
4	Inference	11,67	Low	81,68	High	0,79	High
5	Eksplanation	11,67	Low	88,35	High	0,87	High
6	Self Regulation	10,00	Low	86,68	High	0,85	High

Difference Test of Student Critical Thinking Skills Before and After Using the MCTS Model

Table 6 shows the results of a statistical test of critical thinking skills in a research methodology course using the Wilcoxon's Signed Rank Test to get the sig value. <0.05. These results show that there was a significant increase in critical thinking skills in physics education students in research methodology courses after using the MCTS model.

Tabel 6. Wilcoxon's Matched Pairs Test Results for Critical Thinking Skills

Score *Pretest-Posttest*	N	Mean	*Asymp. Sig. (2-tailed)*	Resume
Research Metodology	20	12,9500 87,5000	0,0000,000	H_0 Rejected

Critical Thinking Disposition

The instrument used to measure students' critical thinking dispositions in this study is PDBK in the form of self-rating critical thinking disposition which contains questions that lead to seven characteristics of critical thinking tendencies, namely the California Critical Thinking Disposition Inventory (CCTDI). Retrieval of data in the form of disposition (tendency) to think critically is done by filling in the self-rating of critical thinking disposition that is shared with students before and after completing learning research methodology with the MCTS model. The details of critical thinking disposition data for each individual are shown in Table 7.

Tabel 7. Scores of Individual Critical Thinking Disposition

Student Intitial	Pretest		Posttest	
	Score	Criteria	Score	Criteria
M1	5,00	Negative	75,00	Positive
M2	5,00	Negative	75,00	Positive
M3	25,00	Negative	75,00	Positive
M4	5,00	Negative	85,00	Positive
M5	10,00	Negative	80,00	Positive
M6	10,00	Negative	75,00	Positive
M7	15,00	Negative	70,00	Ambivalent
M8	10,00	Negative	95,00	Positive
M9	15,00	Negative	85,00	Positive
M10	20,00	Negative	85,00	Positive
M11	15,00	Negative	65,00	Ambivalent
M12	15,00	Negative	90,00	Positive
M13	15,00	Negative	75,00	Positive
M14	5,00	Negative	90,00	Positive
M15	10,00	Negative	85,00	Positive
M16	20,00	Negative	80,00	Positive

M 17	5,00	Negative	85,00	Positive
M18	10,00	Negative	85,00	Positive
M19	10,00	Negative	85,00	Positive
M20	20,00	Negative	95,00	Positive
Average	**12,25**	**Negative**	**81,75**	**Positive**

Data in Table 7 shows that the critical thinking dispositions in the research methodology courses possessed by physics education students before using the MCTS model are classified as negative criteria. The implementation of limited trials of the MCTS model has an increasing impact on critical thinking dispositions. The data in Table 6 shows that after using the MCTS model there is an increase in critical thinking dispositions for each individual. Almost all students have a positive disposition level and only 2 (two) students have ambivalent critical thinking dispositions, namely M7 and M11. Classically, the average student's critical thinking disposition is 81,75 in positive criteria.

Table 8 reveals that the achievement of student scores for all indicators of critical thinking disposition at prestige is in the negative category and the posttest is in the positive category. The lowest student disposition is inquisitiveness, which is 61.67 with a positive category. This result reflects that students humbly acknowledge that in themselves there is still inaccuracy in critical thinking dispositions. Thus, the disposition of students in critical thinking must be improved, but this result also shows that by practicing continuously for 6 (six) meetings and 12 (twelve) journal analysis activities, the students' critical thinking disposition can be maximally produced.

The data in Table 8 show details of the achievement of critical thinking disposition scores in research methodology courses before using the MCTS model all critical thinking disposition indicators are classified as negative criteria. All questions for critical thinking dispositions are classified as sensitive. There are changes in scores and criteria for all critical thinking disposition indicators after using the MCTS model classified as positive criteria. Achievement of the highest Indicator is truth-seeking and maturity, showing the relevance of student activities in the process of critical thinking is very good.

Table 8. Analysis of Pretest Posttest scores of Each Indicator Critical Thinking Disposition

No	Indicator	Pretest	Category	Postest	Category
1	*Truth-seeking*	10,00	Negative	83,33	Positive
2	*Open-mindedess*	16,67	Negative	78,33	Positive
3	*Self-confidence*	8,33	Negative	78,33	Positive
4	*Analyticity*	16,67	Negative	80,00	Positive
5	*Systematicity*	6,67	Negative	80,00	Positive
6	*Inquisitiveness*	5,00	Negative	61,67	Positive
7	*Maturtuty*	10,00	Negatif	83,33	Positive

Difference Test of Student Critical Thinking Disposition Before and After Using the MCTS Model

Table 9 shows the results of the statistical test of the disposition of critical thinking in research methodology courses using the Wilcoxon's Signed Rank Test to get the sig value. <0.05. These results show there was a significant increase in critical thinking dispositions in physics education students in research methodology courses after using the MCTS model.

Table 9. Wilcoxon's Matched Pairs Test Results for Critical Thinking Disposition

Score *Pretest-Posttest*	N	Mean	*Asymp. Sig. (2-tailed)*	Resume
Research Metodology	20	12,2500 87,5000	0,000 0,000	H_0 Rejected

Student Response to the MCTS Model

Student responses to the implementation of learning using the MCTS model are obtained based on the results of filling in the response questionnaire by each student. Questionnaires are given and filled out by students after the learning is completed. In general, the percentage of student responses to learning with the MCTS model and learning tools in limited trials is above 90% with very positive criteria and the average response of physics education students to the application of learning models and devices to the MCTS model in research methodology subjects is 96% positive .

CONCLUSION

The MCTS model that has been developed has effective criteria. Critical thinking skills of physics education students at Palangka Raya University has increased significantly, with $\alpha = 5\%$, N-gain average critical thinking skills are consistently at high criteria. Critical thinking disposition of students experienced a significant increase in high criteria. Physics education students at Palangka Raya University averaged 95.33% giving a positive response to learning using the MCTS model and its devices.

REFERENCES

Arikunto, S. (2010). *Prosedur penelitian: Suatu pendekatan praktek.* Jakarta: Rineka Cipta.

Avalos, B. (2011). Teacher professional development in teaching and teacher education over ten years. *Teaching and Teacher Education, 27*, 10-20.

Beachboard, M. R., & Beachboard, J. C. (2010). Critical thinking pedagogy and students perceptions of university contributions to their academic development. *The Interational Journal of An Emerging Transdiscipline, 13* (1), 53-71.

Chandra, V., & Loyd, M. (2008). The methodological nettle: ICT and student achievement. *British Journal of Educational Technology, 39* (6), 1087-1098.

Costa, A. L., & Pressceincen, B. Z. (1985). *Developing minds: A resource book for teaching thinking.* Alexandria: ASCD.

Darling Hammond, L., & Richardson, N. (2009). Teacher learning: What matters? How teachers learn. *Research Review, 66* (5), 46-53.

Facione, P. A., Giancarlo, C. A., Facione, N. C., & Gainen, J. (1995). The disposition toward critical thinking. *Journal of General Education, 44* (1), 1-25.

Facione, P. A. (2015). *Critical thinking: What it is and why it counts.* Dipetik November 24, 2016, dari https://www.insightassessment.com/content/.../ what&why.pdf.

Fraenkel, J. R., & Wallen, N. E. (2012). *How to design and evaluate research in education.* New York: The McGraw-Hill Companies, Inc.

Fullan, M. G. (2001). *The new meaning of educational change.* New York: Teacher College Press.

Ijaiya, N. Y., Alabi, A. T., & Fasasi, Y. A. (2011). Teacher education in Africa and critical thinking skills needs and strategies. *Research Journal of Business Management, 5* (1), 26-34.

Koster, B., Brekelmans, M., Korthagen, F., & Wubbels, T. (2005). Quality requirements for teacher educators. *Teaching and Teacher Education , 21* (2), 157-176.

MaKinster, J. G., Barab, S. A., & Keating, T. M. (2001). Design and implementation of an online professional development community: A project - based learning approach. *Educational Technology Research and Development, 49* (4), 71-96.

Manali, O. (2016). Developing critical thinking skills. *Chemistry Education Research and Practice, 1*, 72-79.

Miri, B., David, B. C., & Uri, Z. (2007). Purposely teaching for the promotion of higher order thinking skills: A case of critical thinking.

Springer Science+Business Media, 37, 353-369.

Miri, B., & Dori, Y. J. (2009). Enhancing higher order thinking skills among inservice science teachers via embedded assesment. *Springer Science+Business Media, 20* (5), 459-474.

Novak, & Gowin. (1985). *Learning how to learn.* Cambridge: Cambridge University Press.

OECD. (2008). *21st Century Skills: How can you prepare students for the new Global Economy?* Paris: OECD Publishing.

Phan, H. P. (2010). Critical thinking as a self-regulatory process component in teaching and learning. *Psicothem, 22* (2), 284-292.

Rahman, R. J., Setiawan, W., & Fitrajaya, R. E. (2008). Optimalisasi macromedia flash untuk mendukung pembelajaran berbasis komputer pada Program Studi Ilmu Komputer FPMIPA UPI. *Jurnal Pendidikan Teknologi Informasi Dan komunikasi, 1* (2), 1979-1992.

Rienties, B., Brouwer, N., & Lygo-Baker, S. (2013). The effects of online professional development on higher education teachers' beliefs and intentions towards learning facilitation and technology. *Teaching and Teacher Education, 29*, 122-131.

Sahlberg, P. (2010). *The secret to finland's success: Educating teachers.* California: Stanford Center for Opportunity Policy in Education.

Savittree, R. A., Padilla, M. J., & Tunhikorn, B. (2008). The development of pre service science teachers professional knowledge in utilizing ICT to support professional lives. *Eurasia Journal of Mathematics, Science & Technology Education, 5* (2), 26-38.

Snoek, M., Swennen, A., & Van der Klink, M. (2011). The quality of teacher educators in the European policy debate: Actions and measures to mprove the professionalism of teacher educators. *Professional Development in Education, 37* (5), 651-664.

Sunaryo. (2011). Analisis kompetensi guru fisika dalam mengimplementasikan KTSP di SMKN di propinsi Lampung. *Cakrawala Pendidikan, XXX* (3), 505-520.

Swennen, A., Jones, K., & Volman, M. (2010). Teacher educators: Their identities, sub-identities and implications for professional development. *Profesional Development in Education, 36* (1-2), 131-148.

Woolfolk, A. (2009). *Educational psychology.* New York: Pearson.

Yang, Y. T., & Chou, H. A. (2008). Beyond critical thinking skills: Investigating the relationship between critical thinking skills and dispositions through different online instructional strategies. *British Journal of Educational Technology, 39* (4), 666-684.