

EMPOWERING STUDENT'S CREATIVE THINKING SKILL IN BIOLOGY CLASSROOM: POTENTIAL OF GROUP INVESTIGATION COMBINED WITH THINK TALK WRITE (GITTW) STRATEGY

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Abstract

Purpose of Study: Creative thinking skills are indispensable for the investigation of a problem, finding and analyzing facts and data in solving the problem. The role of creative thinking in learning to prepare students to be a problem solver. The lack of empowerment of the creative thinking skills of students in the biology classroom can be caused by the non-optimal application of learning strategies.

Methodology: This study was a quasi-experimental study designed to explore the effect of GI learning strategies, TTW, GITTW, and conventional learning in empowering creative thinking skills of students in high school. The research sample was 162 students of X grade of science majors SMA Muhammadiyah 1 in Surabaya, Indonesia academic year 2015/2016. Creative thinking skills of students measured by essay test given at the beginning and end of the study.

Results: The results showed that the application of learning strategies affected the creative thinking skills of students. GITTW learning strategy can maximize the creative thinking skills empowerment. Also, note that the strategy TTW could improve creative thinking skills were higher than GI and conventional strategy.

Implications/Applications: The GITTW strategy can be considered to be used by teachers as a learning strategy to empower creative thinking skills.

Keywords: *Group Investigation, Think Talk Write, Creative Thinking Skill, Biology Classroom*

INTRODUCTION

One of the efforts to enhance the quality of education that is on aspects of science education. Science education plays an important role especially in generating human resources such as: critical, creative, able to take decisions and solve problems. Science is essentially the product, process, and technology attitudes. As part of the process of national education, science learning should be taken of scientific inquiry (scientific inquiry) in order to foster the ability to think. In the inquiry, the student is expected to be a critical encounter problem in life and creatively seek solutions. Therefore it is necessary to empower the students creative thinking skills to solve problems scientifically.

The fact, biology learning in high school was still dominated by the traditional learning and yet develop thinking skills (S. Mahanal, Zubaidah, Bahri, and Dinnurriya, 2016), like creative thinking skills. Low development and creative thinking skills empowerment impact on the students' creative thinking skills of students in biology to be low (L. Listiana, 2014). In fact, the thinking skills of creative thinking is indispensable for the investigation of a problem, finding and analyzing the facts and data to solve the problems. The linkage of creative thinking in learning to prepare students to be problem solvers reliable. Research of Awang and Ramly (H. Awang, and I. Ramly, 2008) showed that students need creative thinking skills in investigating a problem, formulating a hypothesis, suggesting ways of solving problems and doing a careful analysis. However, if creative thinking skills are not empowered, it will have an impact on the understanding of the concept is low.

Development and empowerment of creative thinking skills can be conducted by applying a variety of learning strategies. The use of appropriate learning strategies is one way to empower the creative thinking skills of students. Through the learning phase, the learning activities of students will encourage creative thinking students. Creative thinking skills that students cannot be obtained instantly but need a process and need to be trained during the class. This is in line with the results of Kaufman & John proved that training the creative thinking skills in students was very important in the learning process.

Required an effort to overcome the above problems, including the application of appropriate learning strategies. Application of appropriate learning strategies is expected to improve creative thinking skills that have an impact on

student learning outcomes biology. Bahri & Corebima ([Bahri and Corebima, 2015](#)) reported that there was a correlation between thinking skills and learning outcomes. Empowerment creative thinking skills can be conducted by trained in any activities in the classroom. The effort of creative thinking skills empowerment can be trained through the use of the approaches, strategies or specific learning methods. For example through inquiry learning, ([Mahanal, Zubaidah, Bahri, and Dinnurriya, 2016](#); [Listiana, 2014](#); [Awang, and Ramly, 2008](#); [Kaufman, and John, 2002](#); [Yusa, 2009](#); [Bahri, and Corebima, 2015](#); [Hojati et al., 2014](#)) problem-based learning model, demonstration, discussion or question, and answer. ([I. W. Suastra, 2008](#)) Research of [Susantini et al](#) showed that the use of student worksheets was effective to develop creative thinking skills.

One type of cooperative learning, thinking skills was potentially empowering Group Investigation (GI).GI had better strategies to empower students' thinking abilities and skills. ([Susantini, Isnawati, and Lisdiana, 2016](#); [Corebima, 2010](#)) GI effect on creative thinking skills and understanding of the concept of Biology. ([Nasrudin, 2010](#); [Listiana, 2013](#)) GI was a learning strategy in accordance with the constructivist paradigm, where students interact with a lot of information and work in a cooperative situation to investigate the problem, planning, conduct and evaluate presentations. ([Slavin, 2005](#); [Johnson, 2002](#); [Huinker, and Laughlin, 1996](#)) GI allowed students to be directly involved in how to acquire knowledge, not only received. ([Ahmadi, Zamani, & Sarzaym, 2014](#); [M.G. Mitchell, M. Hilary, M. Holder, and D. Stuart, 2008](#)) GI allowed students to conduct an investigation for studies related to the project concept mastery, thinking skills: analyzing, and synthesizing information as efforts to resolve the problem is multi-faceted. ([Suartika, Arnyana, and 2013](#); [Sudewi, Subagia, and Tika, 2014](#))

The use of GI strategy has revealed some advantages, but on the other hand, there is some weakness. Research of ([Pedraja-Rejas, Liliana, Roberto Vega Massó, and Jaime Riquelme Castañeda, 2018](#)) reported that the implementation of GI required considerable time, and difficult to be implemented at the classroom level and the various subject areas. It is required a learning strategy that is expected to cover the weakness of GI. Another learning strategy which is expected to empower and develop creative thinking skills as well cover the weaknesses of GI is Think Talk Write (TTW). TTW was a cooperative learning strategy introduced by [Huinker and Laughlin](#), ([Fraenkel, and Wallen, 2009](#)) has the advantage of being more flexible and easy to implement in a variety of fields of study of various levels, has very simple phases. ([Hidayat, 2012](#); [Yuanari, 2011](#)) reported that TTW strategy proven can increase the ability of critical thinking and creative problem-solving.

Both GI and TTW strategy is already known and been implemented by teachers, but its application in learning is still not optimal. Limitations of TTW are the learning phases are very simple and every step of the stage think, talk, and write technically unclear. It is the primary consideration to integrate with GI strategy. Instead, limitations on GI can be complemented by TTW. Both of these strategies combined with integrating the phase of TTW at every stage of GI. Integration of GI and TTW (GITTW) packaged in the form of cooperative learning, which trains students to think to investigate a topic of real or theoretical issues, access information from a variety of sources, observation, analysis, synthesize, presentation and evaluation. It can develop and empower the creative thinking skills of students. Based on that fact, it is necessary to compare the effect of applying GI strategy, TTW, GITTW, and conventional learning in empowering creative thinking skills of students.

EXPERIMENTAL DETAILS

This study was a quasi-experimental design, because there may be several factors that affect the variables that cannot be controlled. The study was designed by pretest-posttest control group design (Table 1). The independent variable was the learning strategy consists of the Group Investigation (GI) strategy, Think Talk Write (TTW), Group Investigation combined with Think Talk Write (GITTW) and conventional learning strategies. The dependent variable was the creative thinking skills of students. The research was conducted during one semester in odd semester of 2014/2015 academic year.

Table 1: Quasi-experimental research design.

Pre-test	Group	Post-test
T1	X1	T2
T1	X2	T2
T1	X3	T2
T1	X4	T2

Where,

X1 = GI Strategy; X2 = TTW Strategy; X3 = GITTW Strategy; X4: Conventional Strategy; T1 = pre-test scores; T2 = post-test scores

The sample of research included 162 students of the tenth grade of science major academic year 2014/2015 in SMA Muhammadiyah 1 in Surabaya, Indonesia. The samples were carried out by random sampling. The number of classes used 8 classes, where each learning strategy represented each of the two classes. The classes were used as samples tested in advance equality using data placement test for the provision of multiple-choice tests on biological materials junior level as much as 25 numbers. Analysis equivalence class test sample is done by using analysis of variance (ANOVA) using SPSS 17.0 for Windows.

Measurement creative thinking skills include four aspects: fluency, flexibility, originality (authenticity), and elaboration. (Barrows, 2006; Torrance, 1998, Pantiwati, 2010, Arnyana, 2004) To measure creative thinking skills used test essay integrated with a cognitive achievement test consisting of 13 numbers. Essay test administered before (pretest) and after learning (posttest). Essay test developed by researcher refers to aspects and indicators of creative thinking. For scoring student answers by giving value in accordance with the assessments made rubric, creative thinking skills rubric adapted from (Ansari, 2004) and (Santayasa, 2008 ; Marzuki, 2006) consist of 5 scales (0-5) as a reference to check the answer to each item. The instrument used to first do validation that experts and empirical validation. Validation consists of expert content validity and constructs validity. The results of the validation of three experts obtained value 3:54 (valid). Validation consists of empirical validity test items, test reliability item, level of difficulty and distinguishing features. Empirical validation conducted on 42 students of class XI 1st semester of high school science majors. Empirical validation results obtained by the validity of the test is in the range 0.47-0,82 essay showing that the test is valid and reliability of the test amounted to 0.873 (high reliability) means that the test has been of good quality.

This research data is the creative thinking skills scores of the students' answers on the essay test. Test data collected during the pretest and posttest. Data were then analyzed by ANCOVA, which first tested the prerequisite that normality test using one test-sample Kolmogorov-Smirnov test and homogeneity test using Levene's Test of Equality of Error Variances. Data were analyzed using SPSS 17.0 for Windows.

RESULTS AND DISCUSSION

Summary of ANCOVA of creative thinking skills in every biology learning strategies (GI, TTW, GITTW, and conventional strategy) are shown in Table 2 and the Least Significant Difference test are shown in Table 3.

Table 2: The summary of the analysis of covariance on students' creative thinking skills.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16831.855 ^a	4	4207.964	60.447	<0.001
Intercept	5061.532	1	5061.532	72.708	<0.001
Creative Strategy	4005.937	1	4005.937	57.544	<0.001
Error	9180.408	3	3060.136	43.958	<0.001
Total	10929.496	157	69.615		
Corrected Total	342251.938	162			
	27761.351	161			

Table 3: The results of the post hoc test on the effect of teaching strategy on students' creative thinking skills.

Learning Strategy	X Creative	Y Creative	Gain	Creative Cor	LSD Notation 0,05
GITTW	27.815	53.613	25.798	52.684	a
TTW	25.208	47.333	22.125	48.415	b
GI	29.863	45.899	16.036	43.391	c
CONV	23.357	29.863	6.506	32.372	d

Based on the results ANCOVA test of creative thinking skills of students, it appears that learning strategies influence the creative thinking skills of students ($p < sig. 0.05$). Based on the results of LSD test shows that the average value of corrected creative thinking skills of students who are taught by a different strategy GITTW 8.1% was significantly higher than TTW strategy, 17.6 % higher than the strategy GI and 38.6 % higher than conventional.

The results showed that the application of different learning strategies provides a different effect on students' creative thinking skills. In line with several studies by Suartika, Hidayat, Pantiwati, and Utama reported that learning strategies influence the creative thinking skills of students. The results of the study revealed that GITTW strategy proved to be potentially to empower the creative thinking skills of students compared with GI, TTW and conventional strategy. Potential GI to empower creative thinking skills of students is higher than the conventional strategy, but the potential for TTW strategy proved to be higher than the GI strategy. These results indicate that strategy TTW and GI strategy is a strategy that has the potential to improve the skills of creative thinking. The findings of the research are more important is that the strategy GITTW has enormous potential to develop and improve the skills of creative thinking of students.

GI strategy can affect thinking skills and creative thinking abilities of students to encourage the emergence of creative thinking of students to solve the problems. The results of this study are consistent with results of previous studies. As research conducted by (Pun, 2012; Supriyono, 2011) reported that GI cooperative learning was potentially to empower the students' thinking skills than STAD. Research of (Tan, Gallo, Jacobs, and Lee, 1999) showed the use of Group Investigation could improve creative thinking ability of students. Research of (Yarullin et al., 2016) showed the differences in the creative thinking skills of students who taught by Group Investigation. Creative thinking skills that students cannot be obtained instantly but need a process and need to be trained during the class. According to Yusa, also revealed the importance of creative thinking skills to train the students. Life is very complex and fraught with problems, if students are not trained to think creatively it will be difficult to find a solution to solving the problem.

Based on the characteristics and stages of GI strategy oriented to the development of thinking skills of students. It is seen that in every GI syntax requires students to be more creative when students are exposed to real-life problems. It gives the student an opportunity for the identification, investigation, analysis, and synthesis in solving problems that subsequently made by a presentation and discussion of the final results. When the process of understanding the concept students learn actively, both active thinking (minds-on) and active in doing (hands-on), which shared learning groups provide opportunities for individuals to be involved in the process of thinking and learning.

The stages in GI encourage the students to bring and develop new ideas as a development of the previous ideas and develop skills to investigate and solve the problems diverges. GI strategy has a big potential to train students' thinking processes that lead to creative thinking skills. In accordance opinions, Santyasa that GI involved high level thinking skills in the completion of tasks. Research of Nasrudin and Azizah also revealed that the implementation of the cooperative model GI type can improve thinking skills and scientific attitude of students. Similarly, research of Suartika¹⁴ and Utama²⁸ revealed that learning with GI strategies improved creative thinking skills of students. It can be said GI strategy has great potential to develop and improve the skills of creative thinking of students.

In addition to GI strategy, GITTW strategy cannot be separated from TTW strategy. TTW strategy through the syntax involves the activity of thinking, talking, and writing, these activities give students the opportunity to actively participate in learning and develop their creative thinking skills. Think at this stage, according to (N. Sulistyaningsih, 2012) that a person's thinking covered several dimensions, among others, critical and creative thinking, that thought process includes the creation of concepts, principles, understanding, problem-solving, decision-making, research, drafting and oral discourse. Correspondingly Ansari on stage think of a strategy TTW, students think considered to decide things, formulate concepts, analyze, synthesize and draw conclusions.

The next phase of talk and write, here students require thinking skills and learning skills in communicating ideas, discussions in the form of solutions to problems shared by other groups. As Dewey and Vigotsky, suggests that our thoughts and ideas are built through communication with others. This is in line with research Supriyono reveal that mathematical communication skills of students increased with the implementation of the strategy TTW. Likewise, the writing phase, the student wrote the work in a written report that requires thinking skills to organize all the work so that a complete and easy to understand. According to Yamin, the activity of the students' writing includes writing the solution to the problem, organize all the work and correct it, and believes that the best job. This is in line with Sulistyaningsih showed that the students' ability to write summaries better with TTW strategy. Therefore, it can be said that the strategy TTW potential to improve creative thinking skills of students. In line with the results of research Hidayat revealed that the increase in critical thinking skills and creative math students taught by TTW strategy.

Implementation of the strategy GITTW able to empower the creative thinking skills of students. This is evidenced by the increasing ability of the students in asking questions, planning and sharing tasks, delivering lots of ideas, and conduct an investigation. Stage identify subtopics based discourse or image allows students to convey an idea or ideas and develop ideas that already exist, these activities develop aspects of current thinking skills (fluency) of creative thinking skills.

Similarly, the planning stage and share their work with members of the group. Stage of the investigation in which students conduct an investigation to find and collect data to discuss subtopics, this activity to train students to find and observe objects that can stimulate thought or idea. These activities develop aspects of originality. Phase analysis and synthesis enables students to develop the capacity to think that the idea or ideas can be developed in greater detail; these activities improve students' skills in aspects of elaboration. At the stage of presentation of the final results of student conduct discussions and brainstorming to answer questions. Here allows a lot of questions from members of the other group, the activities at this stage increases the ability to think flexibly (flexibility). Recently a teacher and student (group) collaborated to evaluate the learning undertaken, assessing core competencies which focused on achieving an understanding

GITW strategy believed to enhance the creative thinking skills of students, it is visible at each stage of the strategy GITW students are faced with complex problems that require solving or solutions. For troubleshooting requires skill in generating new ideas or develop ideas that have been there before. Necessary thinking skills in identifying, planning tasks, investigating, analyzing, mensintesis until the conclusion as a solution to the problem. The thought process (phase think) on each of these learning activities is habituation to melatihkan creative thinking skills, as well as on stage talk and write to communicate and write down ideas as the work is very encouraging in empowering creative thinking skills. This is consistent with the statement of Kaufman & John and Yusa how important it is to train creative thinking skills in students.

GITW strategy as a form of cooperative learning model is very encouraging creative thinking skills empower the students. Through the learning group of students together to complete the task, they interact to investigate, analyze and synthesize the later discussion to share ideas with members of the group. With this kind of learning helps students understand and integrate the many perspectives on issues, share ideas, develop ideas that have been there and they learn from each other, so this is believed to empower the creative thinking skills of students. According to a statement quoted by Tan is believed to increase cooperative learning and creative thinking skills in various ways. Correspondingly Pun stated very pleasant group learning and effectively improves the ability to think creatively to solve problems

CONCLUSION

Based on the discussion and research findings, it can be concluded that the application of learning strategies influence creative thinking skills. GI strategy and TTW alloys in the form of cooperative learning proven to maximize the students' creative thinking skills empowerment, TTW strategy also able to enhance creative thinking skills higher than GI and conventional strategies. Therefore GITW strategy can be considered for use as an alternative teacher in the learning strategies that can empower creative thinking skills. For further research is necessary to study the effect of the strategy GITW related to other variables such as critical thinking skills, self-regulated learner, motivation and scientific attitude of students.

REFERENCES

- S. Mahanal, S. Zubaidah, A. Bahri, and M.S. Dinnurriya, *Asia-Pacific Forum on Science Learning and Teaching*, 17, 1 (2016)
- L. Listiana, *Realitas pengembangan keterampilan berpikir dalam pembelajaran biologi: studi pendahuluan di SMA Muhammadiyah Surabaya* (The reality of developing thinking skills in biology learning: a preliminary study at SMA Muhammadiyah, Surabaya). *Proceedings of National Seminar & Workshop Biology/Science Teaching, Universitas Negeri Malang, Indonesia, November* (2014).
- H. Awang, and I. Ramly, *International Journal of Human and Social Sciences*, 3, 334 (2008).
- J.C. Kaufman, and B. John, *The Korean Journal of Thinking & Problem Solving*, 12, 5 (2002)
- I.M.D. Yusa, *Pengaruh model pembelajaran dan setting pemecahan masalah terhadap kinerja pemecahan masalah dan kemampuan berpikir kreatif siswa kelas VIII SMPN 4 Busungbiu* (The influence of learning model and problem solving setting on problem solving performance and creative thinking ability of grade VIII students SMPN 4 Busungbiu). (Unpublished thesis) Universitas Pendidikan Ganesha, Indonesia. (2009).
- A. Bahri, and A.D. Corebima, *Journal of Baltic Science Education*, 14, 487 (2015).
- Hojati, M., Rezaei, F., & Irvani, M. R. (2014). Study the Effects of Cognitive and Metacognitive Learning Strategies to Increase Student Motivation and Probation of Sama Vocational Schools Probation Students of Najaf Abad Branches in School Year 2013-2014, *UCT Journal of Management and Accounting Studies*, 2(2): 35-40.

- Selomo, M. R., and Govender, K. K. (2016). Procurement and Supply Chain Management in Government Institutions: A Case Study of Select Departments in the Limpopo Province, South Africa. *Dutch Journal of Finance and Management*, 1(1), 37. <https://doi.org/10.20897/lectito.201637>
- V.M.Y. Cheng, *Asia Pacific Forum on Science Learning and Teaching*, 11, 1 (2010).
- I. W. Suastra, Teaching science model for developing students' creative thinking ability. *Proceedings The 2nd International Seminar on Science Education*, *Proceedings The 2nd International Seminar on Science Education*, Bandung, Indonesia, October (2008).
- E. Susantini, Isnawati, and L. Lisdiana, *Journal of Science Education*, 17, 79 (2016).
- A.D. Corebima, Berdayakanketerampilanberpikirselayampembelajaransains demi masa depan kita (Thinking skills empowerment during science lesson for our future), *Proceedings of Science National Seminar*, Universitas Negeri Surabaya, Indonesia, Januari (2010).
- H. Nasrudin, and U. Azizah, Improvement thinking skills and scientific attitude using the implementation of group investigation cooperative learning contextual oriented at acid, base and salt topic in junior high school, *Proceedings of the 4th International Conference on Teacher Education*. Join Conference UPI & UPSI Bandung, Indonesia. November (2010).
- L. Listiana, Pembelajaran Biologi dengan model kooperatif tipe GI (Group Investigation) dan TTW (Think Talk Write) untuk memberdayakan keterampilan berpikir (Biology learning with Group Investigation) and Think Talk Write model to empower thinking skills), *Proceedings of National Seminar 10th Biology, Science, and Environmental*, Universitas Negeri Sebelas Maret, Surakarta, Indonesia, July (2013),
- K. Suartika, I.B. Arnyana, and G.A. Setiawan, *E-Journal Program Pasca Sarjana Universitas Pendidikan Ganesha Program Studi IPA*, 3, 13 (2013).
- S. Sudewi, I.W. Subagia, and I.N. Tika, *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA*, 4, 5 (2014).
- Ahmadi, A. K., Zamani, M., & Sarzaym, M. (2014). A survey of the spiritual intelligence in organizations with an emphasis on Islamic texts. *UCT Journal of Social Sciences and Humanities Research*, 2(2), 29-36.
- M.G. Mitchell, M. Hilary, M. Holder, and D. Stuart, *The Alberta Journal of Educational Research*, 54, 388 (2008).
- R.E. Slavin, *Cooperative Learning: Theory, Research and Practice*, Allyn & Bacon, London, U.K. (2005).
- D.W. Johnson, *Meaningful assessment a manageable and cooperative process*, Allyn and Bacon, USA (2002).
- D. Huinker, and C. Laughlin, Talk you way into writing. In: P. C. Elliot, & M.J. Kenney (Eds). *Years Book 1996. Communication in Mathematics K-12 and Beyond*, NCTM, USA (1996).
- Hidayat, Meningkatkan kemampuan berpikir kritis dan kreatif matematika siswa SMA melalui pembelajaran kooperatif think talk write (TTW) (Increase the critical thinking skill and creativity of senior high school students on mathematics through TTW). *Proceeding of National Seminar of Educational Research and Implementation on Mathematics and Natural Science*, (2012) June; Yogyakarta, Indonesia.
- N. Yuanari, Penerapan strategi ttw (talk talk write) sebagai upaya meningkatkan kemampuan pemecahan masalah dan disposisi matematis siswa kelas VIII SMPN 5 Wates Kulon Progo (The application of TTW (talk talk write) strategy as an effort to improve problem solving ability and mathematical disposition of grade VIII SMPN 5 Wates Kulon Progo students), (Unpublished thesis) Universitas Negeri Yogyakarta, Indonesia (2011).
- Pedraja-Rejas, Liliana, Roberto Vega Massó, and Jaime Riquelme Castañeda. "La importancia de los estilos de liderazgo en la calidad de las unidades académicas universitarias." *Opción* 34.86 (2018): 130-151.
- J.R. Fraenkel, and N.E. Wallen, *How To Design and Evaluate Research in Education*. Seventh Edition, McGraw Hill Companies, New York (2009).
- H. Barrows, *Biochemistry and Molecular Biology Education*, 31, 255 (2003).
- E. P. Torrance, *Torrance Test Of Creative Thinking: Directions Manual and Scoring Guide*, Verbal Test Booklet A, Scholastic Testing Inc. (1998).

- Y. Pantiwati, Pengaruh jenis asesmen biologis dalam pembelajaran kooperatif (think pair share) terhadap kemampuan kognitif, berpikir kritis, berpikir kreatif, dan kesadaran metakognitif siswa SMA di Kota Malang (The influence of type of biological assessment in think pair share model to cognitive ability, critical thinking, creative thinking, and metacognitive awareness high school students in Malang), (Unpublished doctoral dissertation) Universitas Negeri Malang, Indonesia. (2010).
- I.B.P. Arnyana, Pengembangan model belajar berdasarkan masalah di padu strategi kooperatif serta pengaruh implementasinya terhadap kemampuan berpikir kritis dan hasil belajar siswa sekolah menengah pada pelajaran ekosistem (The development of problem-based learning model combined with cooperative strategy and the influence of its implementation on critical thinking ability and high school student learning outcomes in the lesson of ecosystem) (Unpublished doctoral dissertation) Universitas Negeri Malang, Indonesia (2004).
- I.W. Santyasa, Model-model pembelajaran inovatif (Innovative learning models). Working paper, Workshop of Class Action Research for High School, (2008) June-July.
- A. Marzuki, Implementasi pembelajaran kooperatif (cooperative learning) dalam upaya meningkatkan kemampuan koneksi dan pemecahan masalah matematis siswa (Implementation of cooperative learning in an effort to improve the ability of connections and solving students' mathematical problems). (Unpublished thesis) Universitas Pendidikan Indonesia Bandung, Indonesia (2006).
- B.I. Ansari, Implementasi model pembelajaran Think Talk Write (TTW) terhadap pemahaman dan komunikasi matematik (Implementation of Think Talk Write (TTW) toward learning comprehension and mathematics communication). (Unpublished doctoral dissertation) Universitas Pendidikan Indonesia Bandung, Indonesia (2004).
- S. K. Pun, International Journal of Education and Information Technologies, 6, 33 (2012).
- Supriyono, Developing mathematical learning device using TTW (think-talk-write) strategy assisted by learning cd to foster mathematical communication. Proceedings International Seminar and the 4th National Conference on Mathematics Education, (2011) July, Yogyakarta, Indonesia.
- Yarullin, I. F., Prichinin, A. E., & Sharipova, D. Y. (2016). Risk Management of an Education Project. International Electronic Journal of Mathematics Education, 11(1), 45-56.
- N. Sulistyanyingsih, Journal of Educational Research and Evaluation, 1, 21 (2012).
- G. Tan, P. M. Gallo, G.M. Jacobs, and C.K.E. Lee, The Internet TESL Journal, 5, 220 (1999).