



improve understanding of concepts as well as critical and creative thinking skills? This study tries to find out the methods / strategies of learning anything that can be used in physics learning which can also be used to improve the skills of critical and creative thinking.

## 2. Method

This study uses literature analysis study. This method is done by collecting a variety of sources of books, journals, magazines and other sources relevant. After all sources is obtained, conducted in-depth analysis related to the various methods that have been used in teaching physics experts as well as various efforts to improve the skills of critical thinking and creative students.

## 3. Discussion

In an effort to teach critical thinking skills and creative, expert opinions differ on this matter. In general there are two ways. The first of these skills are taught explicitly and directly (Fisher, 2009) and the second is indirect in the sense of teaching along with others such as physics, chemistry history and so on (Liliasari, 2002).

Fisher (2009) are analogous to train critical thinking skills as those who teach the technique of playing basketball. So according to Fisher practice critical thinking skills begins by identifying some of the basic skills that are essential to good critical thinking; then shows some fundamental flaws that tend shown when doing the ways of thinking like that; furthermore shows a model of good thinking; train and finally the type of thinking that students are exposed to real situations that require them to use a method of thinking he had practiced it. Other experts who have conducted research in critical thinking skills, creative thinking and learning physics are shown in Table 1.

**Table 1:** Focus and Results Related Learning Critical Thinking and Creative

<i>Research Result</i>	<i>Research Focus</i>	<i>Author (years)</i>
The results of this method can involve the students to practice making critical judgment, where they can hone the skills of thinking, training critical spirit, began to speak, think and act as if the expert critical thinkers.	Methods to teach critical thinking skills using Socratic questioning techniques in a community of inquiry	Golding, C. (2011) <i>Educating for Critical Thinking: Thought- Encouraging Question in A Community of Inquiry.</i>
The study recommends the teachers and students involved in the discussion to practice asking good questions to improve critical thinking skills, where the results of a new study shows 4 of 6 group discussions that were identified to have a deep level of thinking (critical).	The use of online discussion groups on the middle class to improve critical thinking skills.	Cheong and Cheung. (2008). <i>Online Discussion and Critical Thinking Skills : A Case Study in A Singapore Secondary School.</i>
Approach ask online can develop critical thinking skills and expand control of content	Approach inquire online for improve skills critical thinking	Toledo, C.A. (2006). "Does your Dog Bite? Creating Good Questions for Online Discussions".
Real-world problem solving, open-ended discussions, and experiments based inquiry can improve critical thinking skills and dispositions	Researchers apply learning: (1) real-world problem solving, (2) a discussion of open-ended, and (3) inquiry-based experiments	Miri et al. (2007). <i>Purposely Teaching for the Promotion of Higher-Order Thinking Skills : A Case of Critical Thinking</i>
Use of proficiency level 3 learning strategies, proven to improve learning outcomes of physics which includes attitudes, skills (thinking skills) and knowledge of students.	3 use learning strategies: counterintuitive problems, conceptual change with the co-operative learning, and use of thought experiment	Tiong, H.B. (2002) <i>Promoting Thinking in Science</i>
3 use learning strategies that are proven to improve students' motivation to learn science, creating a cooperative learning environment, and improve thinking skills and creativity in learning science.	3 use learning strategies: teacher questioning, discrepant events, and word <i>Juxtapoz</i>	Chin, C., Khang, G. N., Sai, C. L., & Wah, L. L.K. (2002) <i>Promoting Thinking in Science</i>
The use of questions to support comprehension, problem solving and reasoning. Forcing students to answer questions during the reading will improve learning from text. The next effect is to reduce the use of time in problem solving by 55%.	The use of questions on narrative in multimedia learning environments.	Craig, S. D., VanLehn, K., & Chi. M.T.H. (2008). <i>Promoting Learning by Observing Deep-Level Reasoning Questions on Quantitative Physics Problem Solving with Andes.</i>
Model of creativity presented three separate modes but related activities - problem solving, creative cognition, and social interaction.	The use of web-based technologies to enhance learning creative thinking	Wheeler, S., Waite, S.J., & Bromfield, C. (2002). <i>Promoting creative thinking through the use of ICT</i>
Factors that encourage discussion is the ability to direct teachers to enable the group discussion questions. The limiting factor is the least knowledge of students in the physics of matter and the lack of function groups.	The use of group discussion in teaching problem solving physics	Benckert, S. & Pettersson, S. (2008). <i>Learning Physics in Small-Group Discussions – Three Examples.</i>
The results showed that the use of cooperative learning can improve academic achievement, helping students to understand the concepts of physics and increase students' motivation to learn.	The use of cooperative learning in teaching physics	Ho, F. F., & Boo, H. K. (2007). <i>Cooperative Learning: Exploring its Effectiveness in The Physics Classroom.</i>
The use of pedagogic rules comprising: modeling, coaching, questioning, reflection, and task structuring, can effected	The use of web-based communication Socrates Question to	MacKnight, Carol B. (2000). <i>Teaching Critical Thinking</i>

communications to improve students' critical thinking skills.	improve thinking skills of students.	<i>through Online Discussions.</i>
In a cooperative group that works fine, students can share concepts and procedural knowledge and the role of the argument, asking for clarification, justification, and the elaboration of each other, so that the resulting solution is better than working individually.	Investigations to find the effects of cooperative learning in physics problem solving performance.	Heller, P., Keith, R. & Anderson, S. (1992). <i>Teaching Problem Solving through Cooperative grouping. Part 1: Group versus individual problem solving.</i>
Multimedia can encourage conceptualization and contextualization of the new material presented, encouraging the active involvement of learners in learning, and encourage students' cognitive internal reaction.	Search empirical evidence about the benefits of the use of multimedia in learning.	Cairncross, Sandra & Mannion, Mike. (2001). <i>Interactive Multimedia and Learning: Realizing the Benefits</i>

Based on Table 1 above can be understood that Golding (2011) teaches critical thinking skills using Socratic questioning techniques in a community of inquiry. Toledo (2006) using the approach of asking them online. Macknight (2000) reported the use of web-based communication Socrates Question to improve students' critical thinking skills. Miri et al (2007) apply the learning real-world problem solving, open-ended discussion, and inquiry-based experiments identified can improve critical thinking skills and dispositions. Of some of these studies there is a common method to teach critical thinking skills. The equation looks of questioning and discussion activity that occurs in a group forum to facilitate student interaction.

Chin et al (2002) used three learning strategies that include teacher questioning, discrepant events, and word Juxtapoz in a cooperative learning environment to improve thinking skills and creativity in learning science. Furthermore Tiong (2002) reported the use of three learning strategies that counterintuitive problems, conceptual change with the cooperative learning, and the use of the experiment though proven to improve learning outcomes of physics which includes attitudes, skills (thinking skills) and knowledge of students. Craig, Van Lehn, and Chi (2008) reported the use of questions on the narration in multimedia learning environments. The use of questions to support comprehension, problem solving and reasoning. This method forces students to answer questions during the reading process that can improve learning from text.

From the above it can be concluded that the use of the method asks can improve critical thinking skills. Usage is defined as a group of cooperative learning can also be used to improve critical thinking skills.

Price, et al (2009) on the application of technology in learning may have implications for the development of new knowledge, creative thinking, and good communication skills. Wheeler, Waite, & Bromfield (2002) reported the use of web-based technologies to enhance learning creative thinking. Model of creativity presented three separate modes but related activities that problem solving, creative cognition, and social interaction. This study strengthens evidence linking creative thinking skills with problem solving skills. As said Matlin (2009) that creativity is the discovery of the solution of problems that are new, high quality and useful. So that creativity is the area of problem solving. In other words, the learning method to improve problem-solving skills can also be used to improve the skills of creative thinking.

Cooperative learning is a popular model that is often used in almost all subjects. The use of cooperative learning in physics, among others, by Heller, Keith, & Anderson (1992) conduct an investigation to find the effects of cooperative learning in physics problem solving performance. In a cooperative group that works fine, students can share concepts and procedural knowledge and the role of the argument, asking for clarification, justification, and the elaboration of each other, so that the resulting solution is better than working individually. Benckert & Pettersson (2008) investigated the use of discussion groups in learning physics problem solving. Ho & Boo (2007) investigated the use of cooperative learning in the learning of physics. The results showed that the use of cooperative learning can improve academic achievement, helping students to understand the concepts of physics and increase students' motivation to learn. Allegedly presumably some research on top to represent the use of cooperative learning in physics.

Ornek, Robinson, & Haugan (2008) identify the factors that make the general assumption that physics is difficult. These factors exist related to self-esteem, academic organizers authority, or of the nature of physics. Among the factors related to student, student failure causes the data obtained in physics, among others, the lack of learning, not reading a textbook, do not complete the task or just working on assigned and less practiced matter physics. Besides the lack of mathematical abilities and interests of students to physics. Although reading has long been regarded as the activity of thinking, only in recent years, learning to read comprehensively included in the higher level thinking activities (Shook & Mee, 2002). In the same book Tan & Cheah proposed the use of critical questions to help students think more deeply about the text reading. Furthermore Net-Shek (Shook & Mee, 2002) also showed that the thinking skills can be put at some stage of deconstruction of the text read, understand or respond to the readings.

In the process of reading, usually there will be questions or responses to the reading of books. At the time asking questions and trying to find the right answers to these questions, a process of creative thinking. Many students who do not have the habit of asking questions on what they hear or read. They are usually directly approve or reject it based purely emotional reaction (Goh & Siew in Shook & Mee, 2002). Furthermore, they say that by teaching students to ask critical questions, can be obtained two advantages. First, to improve metacognitive abilities. Knowing the right questions to ask yourself can help students monitor and improve their understanding while making some kind of response to the message. Second, namely to develop

linguistic skills and cognitive skills to evaluate the meaning of the message read.

From the explanation above, the activity of reading needs to be incorporated into the learning stage. It was intended to minimize the negative consequences of the lack of the reading process and to maximize the positive results of the reading process. Critical thinking known as convergent thinking, while creative thinking, known as divergent thinking, it seems the two are mutually exclusive thought process behind or look not related at all. But in fact, the relationship between critical thinking and creativity (creative thinking) has been raised by some experts. Among others, Paul & Elder (2006). Paul and Elder (2006) stated that creativity and critical thinking are two aspects to that kind of purposeful thinking. Like two sides of a coin, critical thinking and creativity are related. Good thinking requires intellectual skills to generalize the results associated with creativity. Good thinking also requires the ability for a person conscious, strategic and critical to the quality of the resulting intellectual. Furthermore it is said, "Critical thinking without skepticism sheer creativity and meaningful only negative, while creativity without critical thinking is a mere novelty". The separation between these two aspects only occur at the level of the concept, while in practice the thinking process is running alongside inseparable. Paul and Elder (2006) believes that the two types of thinking is supposed to integrated learning.

The main role of education is to improve the capacity of students in terms of the development of personality, social, and academic learning (Joyce, et al, 2009). According to social learning theory, cooperative learning will be more meaningful to improve outcomes and enrich students' learning experience. Research results Heller, Keith, & Anderson (1992), Benckert & Pettersson (2008), and Ho & Boo (2007) have shown positive effects of cooperative learning in the learning of physics. However both competition and cooperative learning a great opportunity to affect the performance of the students in the class. However, humans are basically like working together, debate, discussion, and always seeks to rival the competences of the opponent debate or discussion (Sharan, 1990). Lam, et al (2004) found that the positive effect of competition on the results of student performance and motivation to learn in the classroom. While Parrenas and Parrenas (1993) states that cooperative learning can facilitate students to acquire higher learning achievement. Therefore, both the reward individual and team rewards should be there in a cooperative learning environment, the reward for participation in the productivity of the team proved to be very useful (Johnson, Johnson, & Smith, 1998). For that then Wynne (1995) advocated a synthesis of cooperation-competition teaching strategy that combines both the positive aspects of cooperative learning and motivation competition between groups using competition among team collaboration. If placed correctly in the competitive environment, cooperative learning that strengthens the contribution of each individual in achieving collective goals can provide a very positive effect on student learning (Dyson & Grineski, 2001).

Cooperation and competition is a teaching strategy that combines components of cooperative learning with the

positive aspects of motivation competition through inter-group competition among collaborative team, as has been reported the effectiveness of its use by Attle and Baker (2007) on sport management students. As has also been reported Tauer and Harackiewicz (2004) that the combination of cooperative group learning with inter-group competition can increase intrinsic motivation of participants consistently. The findings concluded that a combination of cooperation and competition are able to facilitate motivation, enjoyment and performance of participants. In the proposed learning model, these structures are the tournament session.

Tournament serves as a vehicle for the actualization of the idea and also explore knowledge. This can happen if the questions and answers for the tournament came from the students. However, if the student interactions in fulfillment of competence is not optimal, then the teacher can facilitate constructive interaction through the submission of critical questions to students who are expected to encourage the development of students' critical thinking skills. In addition to the academic aspect, expected activities will also improve the communication skills of the students.

In Indonesia, some high-level thinking skills research has been done. Wiyono (2012) develops interactive multimedia adaptive to improve students' critical thinking skills. Suardana (2010) developed the basic chemistry lab based Balinese culture to improve critical thinking skills. Tawil (2011) developed a computer simulation based learning in lectures waves and optics to enhance creative thinking skills. Fatmawati (2011) develop creative thinking skills of students through project-based microbiology lectures.

Several studies above indicate the use of technology to help improve thinking skills of learners. Craig, Van Lehn, and Chi (2008) reported the use of questions on the narration in multimedia learning environments that can support the understanding, problem solving and reasoning. Cairncross, Sandra & Mannion, Mike (2001) report empirical evidence about the benefits of the use of multimedia in learning. According to the multimedia they can push the conceptualization and contextualization of the new material presented, encouraging the active involvement of learners in learning, and encourage students' cognitive internal reaction.

As in almost all learning strategy, the end of a lesson there should be an opportunity for students to reflect new knowledge in order to become a knowledge structure that is steady. Just like a confirmation stage at this stage of reflection, there must be an affirmation of the teacher of the truth of physics concepts that have been explored by students in the previous stage. This stage can also be filled with the application of existing concepts to be placed in a new situation or learning process is concluded. At this stage, students can formulate and reflect on learning activities.

#### **4. Conclusions and Recommendations**

Based on the description of the characteristics of various learning strategies above, the learning of physics that is deemed appropriate to the characteristics and needs of the students and is proven to increase the critical and creative



thinking skills is learning that contain learning activities together (cooperative learning), read, ask and look for possible answers, in the tournament and ends with a reflection group. The five components still need to be built into a complete learning strategy, learning strategy labeled "B'BeTTeR" assisted MMI, an acronym for Learning together, reading, inquiry, and Reflective Tournament in the group (which in English means cooperative learning, reading, questioning, tournament and reflection. However, it is necessary to study the learning strategy "B'BeTTeR" assisted MMI how that can improve critical and creative thinking skills of students in physics.

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