CRITICAL THINKING AND SCIENTIFIC APPROACH IN EFL CONTEXT: A LITERATURE REVIEW

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ABSTRACT

Critical thinking should be encouraged in English as a Foreign Language learning based on a scientific approach. The present study reviews arguments, opinions, and previous studies on the implementation of scientific approaches in English as a Foreign Language classes for improving student's critical thinking. The review reveals that critical thinking skills cover three aspects: quick thinking, creative thinking, and analytical thinking. To improve the students' critical thinking, teachers play a crucial role in the learning process using innovative learning models based on scientific approaches. Three learning models considered most useful for developing students' critical thinking are discovery learning, problem-based learning, and project-based learning. Through discovery learning, students learn new things by solving the problem and exploring. In problem-based learning, a contextual problem is given at the beginning of the lesson, not the content being discussed. The third, project-based learning, students learn by doing and being enthusiastic with all processes of learning. Since critical thinking skills are crucial for solving language learning problems and beyond, language learning should integrate linguistic contents with the cognitive skills and dispositions, dimensions of critical thinking.

Keywords: critical thinking, scientific approach, EFL

ABSTRAK

Pemikiran kritis harus didorong dalam pembelajaran Bahasa Inggris sebagai Bahasa Asing berdasarkan pendekatan ilmiah. Studi ini mengulas argumen, pendapat, dan studi sebelumnya tentang penerapan pendekatan ilmiah di kelas-kelas Bahasa Inggris sebagai Bahasa Asing untuk meningkatkan pemikiran kritis siswa. Tinjauan tersebut mengungkapkan bahwa keterampilan berpikir kritis mencakup tiga aspek: berpikir cepat, berpikir kreatif, dan berpikir analitis. Untuk meningkatkan kemampuan berpikir kritis siswa, guru berperan penting dalam proses pembelajaran dengan menggunakan model pembelajaran yang inovatif berdasarkan pendekatan saintifik. Tiga model pembelajaran yang dianggap paling bermanfaat untuk mengembangkan berpikir kritis siswa adalah discovery learning, problem-based learning, *dan* project-based learning. *Melalui* discovery learning, *siswa mempelajari hal-hal baru dengan memecahkan masalah dan*

mengeksplorasi. Dalam problem-based learning*, masalah kontekstual diberikan di awal pembelajaran, bukan konten yang dibahas. Ketiga,* project-based learning*, siswa belajar sambil melakukan dan antusias dengan semua proses pembelajaran. Karena keterampilan berpikir kritis sangat penting untuk memecahkan masalah pembelajaran bahasa dan seterusnya, pembelajaran bahasa harus mengintegrasikan konten linguistik dengan keterampilan kognitif dan disposisi, dimensi berpikir kritis.*

Kata kunci: berpikir kritis, pendekatan saintifik, EFL

A.   INTRODUCTION

Learning English as a foreign language should be approached scientifically (Kemendikbud, 2013; Sarwanti, 2016). This approach allows five learning activity dimensions, namely observing, questioning, experimenting, associating, and communicating (Kemendikbud, 2013; Ratnaningsih, 2017; Suyanto, 2018; Zaim, 2017). Observing aims at raising students' curiosity so that they will be triggered to ask questions. Observation is an action for studying a phenomenon or phenomenon. To observe the phenomenon, students used their five senses. The teacher should introduce a phenomenon in order to encourage students to conduct the observation. The second dimension is questioning. Questioning is when students ask questions in order to learn more about the phenomena they are experiencing. Students may ask questions, starting with what, where, where, why, and how. Students can also ask a hypothetical question like "if.... then...". In experimenting, the third dimension, students will do experiments to explore the meaning and learning authentically by themselves. It is an activity to gather information. Students may experiment in class or do field exploration to collect data. There are three stages of the experimental dimension: concept experiments, experimentation, and the quest for knowledge from the internet or books. The fourth, associating, aims at getting the key points of the learning materials or the conclusion of processes done in experiments. The teacher encourages students to present their work, such as organizing details, creating table forms, and using simple statistics. The last dimension is communicating. It means giving students a chance to present what they have learned during all the processes. The results of learning are shared. This task involves oral presentation, writing a report, and creating a product (Suyanto, 2018).

The scientific approach is implemented in Curriculum 2013 (Kemendikbud, 2013). Its implementation has started in 2013/2014 school year by some schools as pilot projects. The results of pilot schools were then evaluated and revised. Some studies showed that the scientific approach in Curriculum 2013 proved to lack critical thinking skill integration in the learning process (Ratnaningsih, 2017; Sari et al., 2019). Meanwhile, critical thinking skill is an important asset and one of the qualities required in the 21st century. Encouraging critical thinking in learning is an urgent need for all students.

Previous research has demonstrated the advantages of fostering critical thinking in learning. The advantages are performing better in the learning process,

being more confident in college or at work, and improving skills such as persuading, communicating, and problem-solving (Changwong et al., 2018; Masduqi, 2011). Those will be optimally achieved if the processes of EFL learning are prioritized the critical thinking development. Considering the advantages of encouraging students' critical thinking, this present research investigates ways of encouraging critical thinking based on the scientific approach in EFL.

B.   LITERATURE REVIEW

One of the keys for children to become autonomous humans in a future competitive existence is critical thinking skills. Students who have critical thinking will perform better in the teaching and learning process and be ready to face the next stage of life, college or working (Changwong et al., 2018; Sari et al., 2019). Critical thinking should be reinforced by reflection, discussion and drafting, and evaluation so that students can involve actively in discussions (Mehta & Al-Mahrooqi, 2015). Besides those activities, teachers can create healthy competitive situations by doing some practical activities such as problem-solving tasks, debates, self-assessment, and peer-assessment while helping students acquire critical thinking and the attitudes to be critical thinkers. The attitudes also involve how students respect differences and are in positive competitive situations. Besides, active and cooperative learning methods may also be used in the teaching-learning process to facilitate students' critical thinking, such as group conversation, discussion, and reciprocal questioning (Marin & Halpern, 2011; Rezaei et al., 2011; Zhao et al., 2016).

In life, critical thinking is a vital advantage. In almost every cycle of processes that people do every day, it is needed (Changwong et al., 2018; Liu et al., 2016; Moon, 2007). As a result, it is a must to be taught to EFL students. Some strategies can be done by considering the students' background, learning, and the teachers being active and always eager to encourage their students' critical thinking. Teachers and students will gain the benefits of being critical thinkers only if they are disciplined. The urgency to develop critical thinking in learning is critical thinking is the key to solving problems (Sari et al., 2019). No exception for the process of learning subjects at schools, the learning process itself uses a scientific approach as one of the characteristics in Curriculum 2013. This approach certainly requires adequate knowledge from the teachers about learning and its implementation in the classroom.

Unfortunately, the scientific approach was not sufficient to improve students' critical thinking without the teachers' active roles in it (Ratnaningsih, 2017; Sari et al., 2019; Marin & Halpern, 2011; Ku, 2009). The use of creative learning models is suggested to resolve this issue in order to strengthen the critical thinking of learners (Boleng et al., 2020; Jumaisyaroh et al., 2015; Rezaei et al., 2011; Sari et al., 2019). Besides innovative learning models, teachers also need to create challenging activities in which students are actively involved so that the learning situation is always dynamic (Masduqi, 2011). Teachers, as the key in the teaching and learning process, need to be creative and innovative (Marin & Halpern, 2011; Marin & Pava, 2017; Zhao et al., 2016)

C. METHOD

The process of this literature review was guided by Aveyard (2010) within the topic of encouraging critical thinking in EFL teaching and learning process based on scientific approach. In presenting the results, fifty-two articles from authoritative journals, books, and other sources were used by showing the experts' opinion and results of those studies. These data have been coherently incorporated to provide a deeper understanding of critical thinking based on scientific approach in EFL.

D. RESULT AND DISCUSSION
1. Critical Thinking Aspects

Improving problem-solving skills is one of the advantages of encouraging critical thinking into learning. There are three aspects of critical thinking in solving problems. Those are quick thinking, creative thinking, and analytical thinking (Mason, 2008). A person needs to be quick, creative, and analytical when facing any problems. These three aspects of critical thinking are desired output of students is facing a complex society (Facione, 2000). It is suggested not to spend much time thinking about a thing, or it will never be solved. Taking time too long to do anything is not efficient for people who work under pressure and must decide any cases quickly. In this situation, quick thinking is essential to be applied. Quick thinking needs practice. It shows the person's quality when they have to face unexpected situations (Facione, 2000). Creativity has fascinated people when it is indulged in any projects (Im et al., 2015). Innovative learning also needs the teachers' creativity to make students 'stay' in the classroom and involve actively in the learning process (Marin & Halpern, 2011; Marin & Pava, 2017; Zhao et al., 2016). Creative thinking is one of the critical thinking aspects applied in solving problems since old or traditional methods may not work for the present condition (Gregory et al., 2013). The third aspect is analytical thinking. To be analytical in solving problems means that besides being quick, the problem solver must be careful in taking a decision or solution by analyzing the reasons, effects, and participants (Husain et al., 2012). Implementing innovative learning models, such as problem-based learning, would enhance analytical and critical thinking in the learning process. (Jumaisyaroh et al., 2015).

In problem-solving, quick thinking, creative thinking, and analytical thinking, three critical thinking aspects are desirable abilities and arrangements for all to face global society. Mason (2008), in his book, sums up what critical thinking is from definitions of philosophers. Critical thinking focuses on at least two terms, skills, and dispositions, by being reasonable, reflective or thoughtful approach, and skeptical. Being persistent in doing the practices of critical thinking development in EFL is highly recommended. It can be applied in some activities about solving real-life problems, establishing open-ended discussion, and doing experiments to answer any issues (Miri et al., 2007).

There is no exact sequence of developing critical thinking (Moon, 2007), no exception in EFL. In EFL, critical thinking can be involved in different activities

because, as Moon explained in her book, critical thinking is an element of thinking behavior. It means that the process of critical thinking development relies on how teachers set the activities of learning the foreign language not only focus on the linguistic features but also two dimensions of critical thinking, namely cognitive skills, and dispositions (Marin & Pava, 2017; Mason, 2008).

According to Marin & Pava (2017), cognitive skills are interpreting, analyzing, evaluating, concluding, clarifying, and self-regulating. Interpretation is an interpreting action towards someone's work that we cannot rely on it, that we have to prove if the work is trusted or right (Urban Dictionary, 2021). Analyzing examines the constitution or structure of something, mainly information methodically and in detail, usually for explanatory and interpretative purposes (Oxford Learner's Dictionary, 2021). Furthermore, according to the Oxford Learner's Dictionary (2021), evaluating shapes an understanding of something's quantity, number, or value, and at the same time, concluding means the last or the final in series of things (Cambridge Dictionary, 2021) and clarifying means to make comprehensible (Merriam-Webster Dictionary, 2021). Moreover, the last one, self-regulating, is monitoring and regulating energy levels, emotions, thoughts, and behaviors in suitable ways and yield positive results, such as well-being, loving relationships, and learning (Cambridge Dictionary, 2021).

Meanwhile, dispositions include inquisitive, rational, open-minded, logical, systematic, truth-seeking, reason-confident (Marin & Pava, 2017). Inquisitive means wanting to know things much or having curiosity too much about something (Cambridge Dictionary, 2021). Rational means based on or compatible with reason or logic (Oxford Learner's Dictionary, 2021). Being open-minded means willing to consider thoughts and perspectives that are new or different from one's own (Cambridge Dictionary, 2021). Logical means being compatible with rationality (Merriam-Webster Dictionary, 2021). Systematic means according to an accepted set of techniques or formal plan (Cambridge Dictionary, 2021). Truth-seeking means looking for something right, valid, or correct. Moreover, reason-confident is feeling or expressing faith in oneself in telling or expressing the cause or something which provides an excuse or justification for an event or circumstance (Cambridge Dictionary, 2021).

Some activities can be done in promoting critical thinking, especially in EFL. However, EFL learning focuses on using language, and the activities are done to trigger the students to think critically. The teachers' job is to make students also focus on being creative, independent, fostering thinking, decision-making, and self-evaluation by using the target language in communication.

The effectiveness of critical thinking instruction does depend on teachers, the deliberate and persistent efforts. Teachers also need to be creative and flexible by using and combining various strategies in designing critical thinking activities in the classroom. Giving explicit instruction was found to be the right way for critical thinking as well as teacher questioning and active and cooperative learning strategies (Marin & Halpern, 2011; Zhao et al., 2016). Using explicit instruction or clear and understandable instruction worked better than giving embedded instructional modes in developing critical thinking. Those activities could stimulate students' critical thinking as the teachers pose higher-level questions and employ

probing questioning techniques in which the students would infer, judge, evaluate, and expand their ideas.

It has been mentioned before that teachers play a crucial role in embedding critical thinking (Marin & Halpern, 2011; Zhao et al., 2016). Meanwhile, every student has different ways that work for themselves as long as they are diligent in doing continuous practice, oral and written. Students may encounter some difficulties in encouraging critical thinking skills. The teachers' task here is to provide learners with opportunities to improve their critical thinking abilities (Mehta & Al-Mahrooqi, 2015; Rezaei et al., 2011).

2.   Innovative Learning Models to Develop Critical Thinking in EFL

Three learning models, discovery learning, problem-based learning, and project-based learning, are suggested to teach learning process-based Curriculum 2013 (Hanafi, 2016). These learning models are further discussed in this review, significantly how they can enhance EFL students' critical thinking.

a.   Discovery Learning

Implementing a discovery learning model in learning will improve the critical thinking of students (Ilhami et al., 2019; Nuryakin & Riandi, 2017; Sulistiani et al., 2018; Yerimadesi et al., 2019). It is done through the complex thinking process, although it takes time to design learning instructions in the discovery learning model, more time than the conventional ones. Therefore, a teacher needs to prepare well-designed discovery learning for their students. Teacher's efforts and persistence are the keys to the success of integrating critical thinking in discovery learning.

The Discovery learning model allows teachers to manage and set their learning process most suitably and interactively for students (Darling-Hammond et al., 2020). This model gives an interactive atmosphere so that all students are involved in all activities with no hesitation. This model gives the teachers chances to have freedom in managing the classes by considering aspects that lead to students' success in learning. Teachers' independence to plan the learning process can be accomplished by planning guidelines to keep students on track (Honomichl & Chen, 2012). The guidance suggested by Honomichl & Chen (2012) is the well-prepared presentation of materials, reflective feedback, and exploring questions and self-presentation. The guidance must be designed so that it gives positive impacts for students in learning and encourages their critical thinking.

The Discovery learning model in the scientific approach is done by observing, experiencing, and giving logical reasons for discussing things (Ellizar et al., 2018). Students are hoped to be active through those activities since the discovery learning model's essence is on student activity and providing direct learning experiences (Piaget, 1973). Meanwhile, Bicknell-Holmes & Seth Hoffman (2000) define the discovery learning model as exploration and problem solving by creating, integrating, and generalizing knowledge, student-centered with fun activities and integrating new knowledge based on students' previous knowledge.

There are six phases to follow when implementing discovery learning. The first phase is stimulation. Students' interest is developed at this point in which they

will feel uncertain, then continue not to generalize, so that there is a desire to explore on their own. The teacher may also begin by asking questions, reading books recommended, and other learning activities that lead to problem-solving training. The stimulus serves to provide conditions for learning experiences that can develop and help students explore materials at this stage. The declaration of problems is the second step. The teacher offers students the opportunity to recognize issues relevant to the learning content based on the stimulus's effects, then one of them is selected and developed in the form of a hypothesis. The third phase is data collection. The teacher also offers students the chance to gather relevant knowledge as much as possible when exploration takes place to show whether or not the theory is valid. This phase is used to answer questions or prove whether a theory is valid, so students can gather different relevant information, read literature, observe items, interview people with resources, and perform their experiments. The fourth phase is data processing. Data processing is information that has been gathered by students either by interviews, observations and then interpreted. All readings of information, interviews, observations are all collected, randomized, categorized, tabulated, measured in a certain way, and interpreted at a certain degree of confidence, even if appropriate. The fifth phase consists of authentication. This phase allows students to carry out careful examinations to show whether or not the predetermined theory is accurate with alternative findings relevant to data processing performance. If the teacher offers students opportunities to find a notion, theory, law, or interpretation through the examples, he experiences in his life, and the learning process can run well and creatively. Generalization is the last phase. This stage is the way to draw a conclusion that can be used as a general principle and, regarding the verification results, applies to all the same events or problems. The concepts that underlie the generalization are formulated based on the verification results (Hanafi, 2016); (Kemendikbud, 2014).

Based on the above analysis, it can be said that discovery learning can improve the critical thinking skills of students. Students learn by discovery, not being told or taught. As the key in learning using discovery learning, teachers design the learning by raising students' curiosity. It is started at the beginning of the learning in which students are triggered to implement three critical thinking aspects: quick thinking, creative thinking, and analytical thinking.

b. Problem-Based Learning

The second innovative learning model, problem-based learning, was proved to be useful in increasing students' critical thinking (Anazifa & Djukri, 2017; Boleng et al., 2020; Jumaisyaroh et al., 2015; Narmaditya et al., 2018). In problem-based learning mechanisms, critical thinking is built when learners learn through the problems they are trying to solve. The students learn by addressing problems in their lives while answering the driving questions from their teachers. In the learning process, students also have ownership since they are permitted to express and use their ideas and collaborate through problem-based learning. Students will also do reflection based on what they have learned and found through the process of learning in which they can revise their project after doing reflection.

Then the final product will be shared with other students in the classroom or other classrooms or even to a professional in the field.

Problem-based learning is successfully used in EFL, especially in improving critical thinking for students (Othman & Shah, 2013; Jumaisyaroh et al., 2015; Lin, 2018). In problem-based learning, teachers do not teach the content, but they give the students problems initially. In EFL learning, problem-based learning poses contextual problems that encourage students to learn. It encourages learners to think, to work in groups to find solutions to real-world issues. The problems are applied to build students' interest to develop the students' critical thinking. Research shows that problem-based learning can give effects on higher success, improved participation, self-directed learning, collaborative skills, more in-depth learning of subject awareness, and the most significant is that it can strengthen the critical thinking of students through which it also strengthens problem-solving skills (Strobel & van Barneveld, 2009; Walker & Leary, 2009).

In problem-based learning, teachers do not teach at the beginning but offer students problems to solve (Lukitasari et al., 2019; Shamir et al., 2008). The problem-based learning syntax can activate how learners encourage their critical thinking. In addition to improving students' critical thinking, problem-based learning can also enable the cognitive process of students through its syntax, which facilitates learning (Şendağ & Odabaşi, 2009; Othman & Shah, 2013).

Teachers' comfortable learning situation through problem-based learning could be practical through some instructional recommendations as stated in Lin (2018). First, ask the student to use the completed agenda with a list of tasks every week. At the end of the fifth week or last week, they have to present their work every week systematically. They also do subtasks such as finding internet information, analyzing and synthesizing the information required for their job. Second, concerning using specific internet resources since not all students have good proficiency in reading English texts. It is hoped that all students with different proficiency can involve in the discussion actively. Third, given the varying proficiency levels of students in English, it is appropriate to allocate them to small classes. Each community may consist of high and low English proficiency so that peer scaffolding can assist each other.

There are five phases in problem-based learning syntax. Those phases are student problem orientation, organizing learners to study, directing group analysis, presenting the work, and reviewing and assessing the problem-solving process in the last phase (Jumaisyaroh et al., 2015). Students would be oriented in the first stage to the problem that has been planned to be solved. Students are trained to improve problem-solving abilities in this process. The second step is to coordinate learners to learn. Teachers can encourage students to work in groups by using problem-based learning to develop problem-solving skills. The groups consist of varied students, variation of skills, male and female students, and scores. Collaboration between group members will help the process of solving problems. The third phase, directing group study, in which the instructor encourages the students in a group discussion to be involved and engaging. The teacher also encourages students to gather knowledge and perform experiments in this process before understanding the aspects of the problem situation (Ertmer & Simons, 2006).

The aim is for students to collect sufficient data to build and construct their ideas. The fourth stage is to show the work. The work or products can be written reports, videos, models, computer programs, and multimedia presentations. The standard of the objects is positively affected by the degree of thought of the students. The next move is to present their work, and the instructor serves as the exhibition's organizer. It will be easier to provide other pupils, teachers, parents, and others with input. Analyzing and reviewing the problem-solving process is the last step. This step is structured to help students study and examine their processes and the analysis and intellectual skills they use. During this period, the teacher asks students to reconstruct the thoughts and activities that have been carried out during the learning process. In summary, by working in groups, students evaluate the data given and decide the critical problem with the teacher's support, the syntax of problem-based learning. Then, they will get more information and feedback from the teacher and their peers after sharing their work (Pecore, 2012).

Problem-based learning is based on student-centered learning, where teachers serve as facilitators (Savery, 2006). The division of roles can be seen through its syntax. Students are pushed to develop their problem-solving skills, be independent learners, and collaborate in groups through real-world problems (Hmelo-Silver, 2004; Pecore, 2012).

c. Project-Based Learning

Project-based learning is one of the learning models which can improve students' thinking, generate original ideas, develop cooperative work, find accessible literary tools, present knowledge, and analyze their outcomes (Kubiatko & Vaculová, 2011). Same like previous learning models, project-based learning can also be used to improve analytical thinking for students (Anazifa & Djukri, 2017; Rochmahwati, 2015; Sasson et al., 2018). It uses the project as the media in which students learn to explore, value, interpret and synthesize information through learning to find out valuable information (Doppelt, 2003; García, 2016).

The teacher serves as a facilitator in the learning process (Kubiatko & Vaculová, 2011). While they are working on their project, facilitating students can be done by guiding and coaching them (Goodman & Stivers, 2010). Those are needed as students may work on unfamiliar territory compared to their daily. This condition pushes them to use their creativity and critical thinking skill. Facilitating the students is also done by collaborating in groups with various students and content experts (Papanikolaou & Boubouka, 2010). By helping them generate their project assignment, the teacher may include students in this process.

Collaboration needs the students to actively engage because they use student-centered learning (Goodman & Stivers, 2010). As project-based learning creates a constructivist learning atmosphere, the learning construction happens by trying to solve problems or answer questions that drive the learning process (Papanikolaou & Boubouka, 2010). Project-based learning can enhance the sense of responsibility of a student for her learning and monitor it. There will be more engaged in learning for students who are allowed to identify their own learning goals.

Project-based learning was found useful in creating a festive learning atmosphere for students as they all engage in the learning process. Besides the

festive learning atmosphere, it was also influential in giving significant affective learning (Doppelt, 2003; Mitchell et al., 2009). Mitchell et al. added the teacher felt successful and that the students could develop their learning by expressing their genuine interests and curiosities and being problem solvers. Besides, this learning model also challenges the teachers to design challenging activities for students. Its design must be well-prepared to develop critical thinking and acquire the knowledge that can be achieved (Rochmahwati, 2015). The points in implementing project-based learning are students learn by doing and being active in the learning process to develop critical thinking. The main feature of project-based learning is problem-solving: students face particular problems, search for solutions, and collaborate with team projects. It is in line with the definition proposed by Goodman & Stivers (2010). They said that project-based learning is based on learning experiences and real tasks that include problems to be solved in groups for learners relevant to daily life.

Students' work is typically terminated by developing a specific product, a thesis, paper, design plan, or model. The products are done by following phases of the learning model, project-based learning (Rochmahwati, 2015). She described that project-based learning has five phases: discussing the materials to understand them more, employed in scenario creation groups, performing the scenario, recording the procedure, and evaluating the procedure from the video that can be viewed.

E. CONCLUSION

One of the skills students must master in the 21st century is critical thinking. Bloom (1956) contributes to critical thinking promotion in learning processes through three phases of higher-order thinking: analysis, synthesis, and evaluation (Miri et al., 2007). Promoting critical thinking is best situated in student-centered learning in which students will find logical reasons, stating opinions regarding proofs, problem-solving, and questioning every information given. These can be found in Curriculum 2013's proposed learning models focused on scientific approaches, such as discovery learning, problem-based learning, and project-based learning models (Hanafi, 2016). Moreover, critical thinking needs discipline, lifelong and persistent practices. Students then will be able to analyze, compare, contrast, find critical points, and make value judgments. For EFL students, critical thinking is applied and learning by using various activities based on a scientific approach. The scientific approach's three learning models are discovery learning, problem-based learning, and project-based learning models, which are clear, systematic, and used to encourage EFL students' critical thinking.

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