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Biology Module Development Using Think Pair Share Strategy to Improve Critical Thinking Skill of Vocational High School Students

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Abstract: ***The purpose of this research and development is to create a product in a form of Biology learning module using think pair share strategy as an effort to improve critical thinking skills of vocational high school students. The research and development method used for this research was Borg & Gall (1985) development model. The development module has fulfilled validity criteria and adequate as a Biology learning material using strategy think pair share to improve critical thinking skills of vocational high school students. Critical thinking data was collected using critical thinking skill test suitable for validity and highly reliable as an instrument. Research shows that Biology module equipped with think pair share has improved the critical thinking skill of vocational high school students with normalized gain score on early field test at 0.77 (categorized as high), main field test at 0.8 (categorized as high), dan operational field test at 0.82 (categorized as high), hence it was recommended to use this Biology module in learning process to improve the critical thinking skill of vocational high school students.***

Keywords: biology module, think-pair-share, critical thinking skill,

1. Introduction

The 21st century science and technology has challenged in every field including education. One of the challenges in education was did the students capable to possess the 21st century skills. Those set of skills are required to allow the students to adapt as the time evolve (Silva, 2009; Voght & Roblin, 2010; Mc Comas, 2014) [1], [2], [3]. In Partnership for 21st Century Skills (2007), stated that the 21st century skills required for students are life and career skills, learning and innovation skills, and information, media, & technology skills. Furthermore, in learning and innovations skills, it focused on critical thinking, communicating, collaborating, and creativity skills [4]. Rotherham & Willingham (2010), suggested that 21st century skills should be applied in existing education [5].

Critical thinking skill is currently one of the most important aspect needed to possessed by students. Ennis (2011) stated that critical thinking is a logical thinking and reasoning focused on conclusion drawing about what they believe and completed [6]. Wagner (2014) mentioned that critical thinking skill and problem solving is a main ability required by students to survive and adapt with progress [7]. According to Rotherham & Willingham (2010) critical thinking and problem solving skills has actually been a part of evolution in the history of mankind, starting at simple farming tools up to existing sophisticated equipment [50]. The challenge nowadays is how those set of skills implemented in a better curriculum. Duron *et al* (2006), point out five steps to allow students thinking critically. Those steps are namely: (1) determine learning objectives; (2) teach through questioning; (3) Practice before you asses; (4) review, refine, and improve; (5) provide feedback and assessment of learning [8]. The statements above prove the importance of critical thinking skill implementation in learning and education.

Critical thinking skills need to be possessed by vocational high school students. This statement was enclosed in Ministry of Culture and Education Regulation number 81A 2013, which clearly stated the set of skill required by students are communication, critical thinking, and creative skills while taking account moral and value of Pancasila to be a democratic and responsible citizen, tolerant in diversity, able to adapt in global community, possess a vast interest in life and ready to work, intelligence according to their interest and talents, and concern about the environment (Permendikbud, 2013) [9]. Anderson *et al* (2001) stated that critical thinking skills are one of the qualification needed by *level 3* vocational students [10]. Furthermore Maudsley & Strivens (2000) stressed out that critical thinking skill is required by students to obtain expertise [11]. Moreover, critical thinking skill required by students are including identifying problem, providing argument, deducting, inducting, evaluating, and decision making skills (Ennis, 1985; & Marzano, 1998) [12], [13]. The importance of critical thinking skill for vocational high school students has influenced the education implementation strategy used by vocational high school teachers in all field of study including Biology.

Biology is a mandatory subject to be learned by vocational high school students in agribusiness and agro-technology, marine and fishery, and public health programs. As one of the part of science study, Biology study should pay attention on the nature of science. According to Carin & Sund (1985), the natures of science are including product, process, and behavior. Therefore, Biology study should not merely transfer products of science (science understanding, theory, law, postulate) to students, but also take account the process and behavior [14]. Biology study needs to consider the process how products of science are invented by scientist. Throughout scientific process, it is needed a set of skills

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called scientific process skill (Roth & Roychoudhury, 1993) [15]. Several aspects in scientific process skill were thinking skills which require critical thinking skills. Therefore, Biology study should be able to develop student's critical thinking skills.

Critical thinking skills are needed by every being in order to be success in their life. John Dewey in 1916 mentioned that educational institution should teach students to think critically. All parents and teachers were agreed if students in school were taught to think specifically regarding critical thinking, because this skill is practical in all aspects of life (Arnyana, 2004) [16].

According to the Biology study survey result at Malang Public Vocational High School 2, Public Vocational High School 11, and Public Vocational High School 13 dated 24th January 2015, we found that critical thinking skills regarding students' understanding regarding identifying problem, providing argument, deducting, inducting, evaluating, and decision making skills were still underdeveloped. Hence it caused student's critical thinking skill to be unused. On the other hand, interview result with Biology teacher in Vocational High School reveal that teachers felt unable to create a learning environment which stimulates critical thinking skill and evaluation test handed out to students did not describe critical thinking. These became the obstacle for critical thinking development in Vocational High School students, whereas student needs to possess those skills nowadays in the 21st century. Numerous efforts are conducted to make students to have critical thinking skills. One of them is using learning strategy which boosted critical thinking skills.

Various learning strategies to improve student's critical thinking skill such as: Sadia (2008) revealed one of the learning strategies used to improve critical thinking skill is using cooperative learning model [17], Prajoko stated that the use of the learning strategy to enhance the critical thinking skills students need to pay attention to character varying [18]. *Think pair share* (TPS) learning strategy is one of the cooperative learning method which stressed out thinking process *(thinking),* pairing and grouping *(pairing),* and contributing (*sharing).* Prior research result shows TPS learning as well as *think pair share* combined with other strategy has helped to improve students' learning motivation, social behaviour, cognitive learning outcome, critical thinking, creative thinking, interest and collaboration within group (Chotimah, 2007; Suyanik, 2010; Haerullah, 2012; & Chotimah 2014) [19], [20], [21], [22].

Critical thinking skills did not develop on its own along as people aging and growing. This thinking skill will be well developed if it's stimulated and intentionally improved. The development of critical thinking skill can be done at school. Hopefully this skill will continue growing, especially if there is an opportunity to develop in school (Bachman, 2005) [23]. This opportunity was utilized by researchers to create product in a form of module supplemented with *think pair share* strategy, which expected to develop student's critical thinking skill.

In order for learning process to go as smooth as possible, appropriate Biology learning material for student's characteristic is necessary. Hernawan *et al* (2012), stated that learning material is crucial as an information source required by students to construct their cognitive knowledge structure [24]. A broad variety of learning material were used in learning process, one of them is learning module. Learning module has their significance in students' independence in learning. The module was suitable with Vocational High School students' characteristic where they are demanded to obtain their knowledge autonomously to enable them to apply it in industrial internship (prakerin) and occupation once they graduated from Vocational High School. Module can also assist teachers in creating quality learning, because module creates a well-planned, independent, complete, learning process with profound results (*outcome*) (Depdiknas, 2008) [25].

The challenges in this research are based on: *Firstly*, critical thinking skill is one of the skill students needed to possess in 21st century. *Secondly*, Survey results revealed that critical thinking skills of the students are still underdeveloped. In which because the implemented learning materials and strategy were incompatible with the development of students' critical thinking skill. Therefore, research regarding the development of Biology module with *think pair share* strategy is necessary to improve the critical thinking skills of Vocational High School students.

2. Method

Module's research and development method are referring from research and the development plan from Bord & Gall (1985) development model [26]. The plan consists of (1) research and information collecting, including literature review, classroom observation, and report drafting, (2) planning, including deciding skill, set goals and learning time frame, and small scale suitability test, (3) develop preliminary form of the product, consist of learning material preparation, guide book, and evaluation tools, (4) preliminary field test, implemented on one to three schools consist of 8 people. Followed with data collecting through interview, observation, and questionnaire, and then analyzed, (5) main product revision based on preliminary field test results, (6) main field testing consist of 59 people. The quantitative data of pre-learning and post-learning are gathered, (7) operational product revision, conducted based on main field test results, (8) operational field testing on 142 people, (9) final product revision based on operational field test results, and (10) dissemination and implementation.

Data collecting instruments consist of critical thinking skill test results which analyzed using descriptive quantitative approach. Critical thinking skills are measured using rubric (Hart, 1994) in scale 0 – 4 [27]. Score of critical thinking skill obtained from converted critical thinking skill rubric score. The formula for critical thinking skill score is as follows:

$$\text{Critical thinking skill score} = \frac{\text{Obtained score}}{\text{Questions total score}} \text{x} 100\%$$

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Critical thinking scoring was characterized referring from Ministry of education and culture (Permendikbud, 2013) as shown in Table 1 [28].

Table 1: Critical thinking score characteristic

Score Interval	Criteria
91-100	Very good
75-90	Good
65-74	Average
54-64	Poor

(Source: Permendikbud, 2013)

The escalation of critical thinking skills can be observed from normalized *gain score*. Grade of normalized *gain score* is a comparison between the average obtained *gain* towards average maximum $\langle G \rangle$ *gain*, which fulfill:

$$\langle g \rangle \equiv \%\langle G \rangle / \%\langle G \rangle_{\max} = \left(\%\langle S_f \rangle - \%\langle S_i \rangle\right)/\left(100 - \%\langle S_i \rangle\right)$$

(Hake, 1998)

with,

$\langle g \rangle$ = Average normalized gain

$\langle S_i \rangle$ = Pre-test average score

$\langle S_f \rangle$ = Post-test average score

Gain score grading criteria according to Hake (1998) can be seen at Table 2 as follows [29].

Table 2: *Gain Score* grading criteria

No	Score $\langle g \rangle$	Criteria
1	> 0,7	High
2	0,7 ≥ $\langle g \rangle$ > 0,3	Medium
3	< 0,3	Low

(Source: Hake, 1998: 1)

Test subjects on preliminary field test on this research and development are total 8 students of Malang Public Vocational High School 13, on main field test 59 students of Malang Public Vocational High School 13 in total and on operational field test was conducted with the combination of 142 students from Malang Public Vocational High School 2 and Malang Public Vocational High School 11. The selection of Vocational High School for field test was done using *purposive sampling*. Data was collected starting in July until December 2015

3. Result and Discussion

3.1 Demand Analysis Result

Data regarding the demand analysis on *think pair share* based Biology learning material are shown in Table 3.

Table 3: Demand of *Think Pair Share* Based Biology Learning Material

No.	Demand Components of TPS based Biology Learning Material	Percentage
1	Students often have difficulties in finding Biology reference book compatible with 2013 curriculum.	45,5
2	Students always have difficulties in finding Biology reference book compatible with 2013 curriculum.	18,2
3	Students sometimes have difficulties in finding Biology reference book compatible with 2013 curriculum.	18,2
4	Students seldom have difficulties in finding Biology reference book compatible with 2013 curriculum.	9,1
5	All teachers of Malang Public and Private Vocational High School stated that students need to learn independently.	100

(Source: Chotimah, 2014:2)

Based on Table 3 we found that 45.5% of Vocational High School students often find difficulties in finding Biology reference book compatible with 2013 curriculum. Biology teachers of Malang Vocational High School also agreed that Vocational High School students need to learn independently. These shows that the demand for Biology learning module which can escalate students' critical thinking skills, and can be used for learning independently are very high. Therefore, *think pair share* Biology Module can be the solution to overcome those difficulties. The demand for TPS based Biology Module are needed by Malang Vocational High School students. It was also supported by the lack of Biology text book variety for Vocational High School program and the unavailability of Biology text book in a form of a module (Chotimah, 2014) [22].

In essence, Biology module with *think pair share* learning strategy for X grade nursery program Vocational High School consist of three parts, namely: preliminary chapter, main chapter, and ending chapter which correlates and have the role to improve the critical thinking skills of X grade nursery students of Malang Vocational High School. It is in accordance with the expected outcome of 2013 curriculum which enclosed in the Ministry of Education and Culture Regulation Number 65 Year 2013 regarding the standard Education process for Elementary and Middle level, where the education principle implemented must not only have the capability to improve *hard skill and soft skill*, but also to develop behavioral, spiritual, social behavior, knowledge and skills competency. Evaluation score results by Biology experts and Biology material experts can be observed on Table 4.

Table 4: Evaluation score results by Biology experts and Biology material experts

No.	Module Aspects	Score (Max: 4)
1	Material's organization	3,63
2	Material's depth and broad range	3,75
3	Material's effectiveness	4,00
4	Material's context	3,50
5	Virus Material	3,75
6	*Archaebacteria* dan *Eubacteria* Material	3,78
7	Fungi Material	3,71
8	*Enzyme* Material	3,86
	Average	3,77

Based on Table 4 we can conclude, that overall average score of Biology module according to the opinion of Biology education experts and Biology Material experts is 3.77. these shows that a module is categorized as very appropriate, very clear, very interesting, very easy, and very precise.

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Module resulted from this research and development based on Borg & Gall development model, is in a form of Biology module for X grade nursery program Vocational High School with *think pair* share learning strategy. Module was produced in a lengthy process involving the judgment from team of module experts, Biology education and material experts, field practitioners, and students' legibility aside from the recommendation from three promotors. The judgment from team of experts are then tested onto students through three trials. The trials referred to are preliminary field test to eight students of Malang Public Vocational High School 13 and then revised. The revised module is used on main field test towards 59 students of Malang Public Vocational High School 13 in total which then revised. Hence the revised module was used on operational field test towards the combination of 142 students from Malang Public Vocational High School 2 and Malang Public Vocational High School 11. After revised into a final product, the module is socialized and disseminated to all Malang Vocational High School Biology teachers.

3.2 Trial Results of Critical Thinking Skill Evaluation Instrument.

Instrument's trial results which including the validity and reliability of critical thinking skill are: 1). Valid number of questions used to obtain data from critical thinking skills are 24 questions, and 2). Reliability coefficient for Virus learning materials is 0.596; *Archaeobacteria* and *Eubacteria* 0.752; Fungi subjects 0.951; and Enzyme subjects 0.947. We can conclude that instruments used to measure critical thinking skill has fulfilled the validity and highly reliable.

3.3 Critical Thinking Skills Test Results.

This critical thinking skills test results consist of three steps of field test namely, critical thinking skill tests on preliminary field test, main field test, and operational field test. Learning materials presented each contain Virus subject, *Archaebacteria* and Eubacteria, Fungi, and Enzyme

1. Critical thinking skill tests result on preliminary field test.
Students' critical thinking skill score data on preliminary field test Based Competency (BC) 1 with Virus subject, (BC) 2 with *Archaeobacteria* and *Eubacteria* subjects, (BC) 3 with Fungi subjects, and (BC) 4 with Enzyme subject are presented in a chart in Figure 1, whereas normalized *gain score* is presented in Table 5.

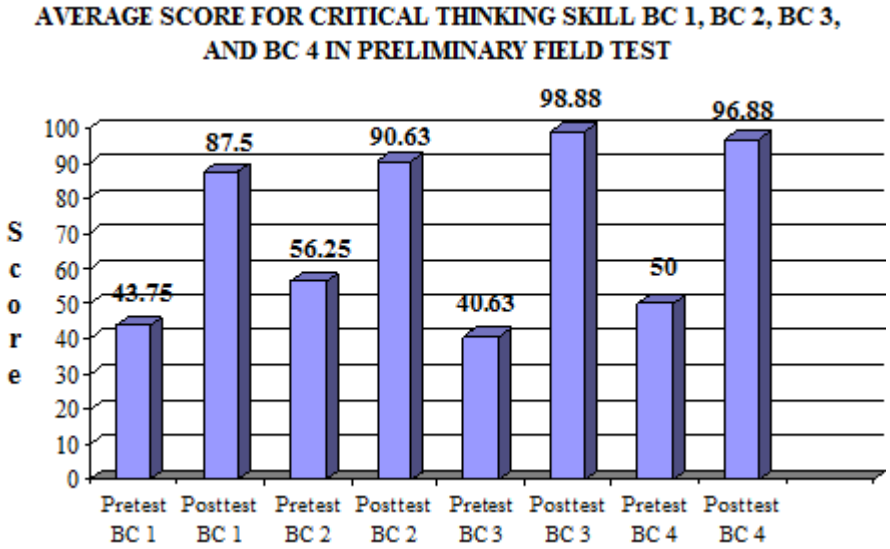

Figure 1: Chart of Average Critical Thinking Skill Score BC 1, BC 2, BC 3, and BC 4 on preliminary field test

Table 5: *Gain Score* grades of each BC on preliminary field test

No.	Learning Subjects	*Gain Score grades*
1	BC 1 (Virus)	0,71
2	BC 2 (*Archaebacteria* and *Eubacteria*)	0,74
3	BC 3 (Fungi)	0,79
4	BC 4 (Enzyme)	0,83
Average		0,77

2. Critical thinking skill tests result on preliminary field test.
Students' critical thinking skill score data on main field test BC 1 with Virus subject, BC 2 with Archaeobacteria and *Eubacteria* subjects, BC 3 with Fungi subjects, and BC 4 with Enzyme subject are presented in a chart in Figure 2, whereas normalized *gain score* is presented in Table 6.

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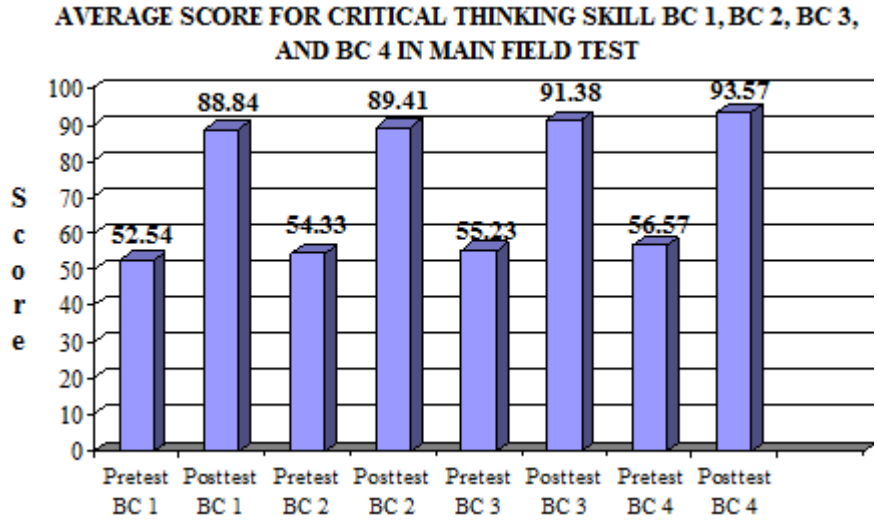

Figure 2: Chart of Average Critical Thinking Skill Score BC 1, BC 2, BC 3, and BC 4 on Main field test

Table 6: *Gain Score* grades of each BC on main field test

No.	Learning Subjects	*Gain Score* Grade
1	BC 1 (Virus)	0,76
2	BC 2 (*Archaebacteria* and *Eubacteria*)	0,77
3	BC 3 (Fungi)	0,81
4	BC 4 (Enzyme)	0,85
Average		0,80

3. Critical thinking skill tests result on operational field test.

Students' critical thinking skill score data on operational field test BC 1 with Virus subject, BC 2 with *Archaeobacteria* and *Eubacteria* subjects, BC 3 with Fungi subjects, and BC 4 with Enzyme subject are presented in a chart in Figure 3, whereas normalized *gain score* is presented in Table 7.

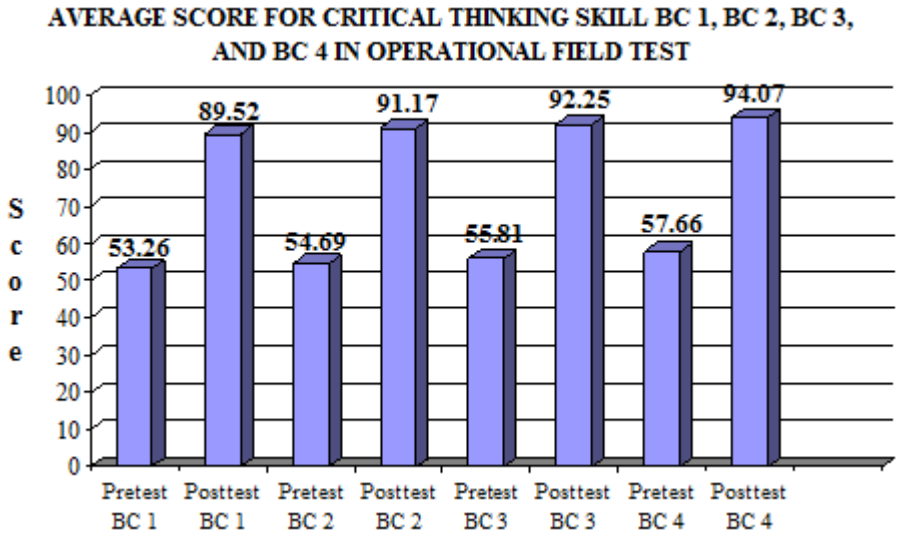

Figure 3: Chart of Average Critical Thinking Skill Score BC 1, BC 2, BC 3, and BC 4 on Main field test

Table 7: *Gain Score* grades of each BC on main field test

No.	Learning Subjects	*Gain Score* Grade
1	BC 1 (Virus)	0,78
2	BC 2 (*Archaebacteria* and *Eubacteria*)	0,81
3	BC 3 (Fungi)	0,82
4	BC 4 (Enzyme)	0,86
Average		0,82

Based on the Figure 1, Figure 2, and Figure 3. We can conclude that in general there are improvement on students' critical thinking skills for all Biology material. The criteria for score improvement on students' critical thinking skills each varied with 'high' category for Virus, *Archaebacteria* and *Eubacteria*, Fungi, dan Enzyme subject. Module with *think pair share* strategy could improve students' critical thinking skill of Malang Vocational High School. Critical thinking skill are developed while using learning process steps of *think pair share* strategy. Therefore, students' critical thinking skill can be taught in school through learning process. As Kronberg and Griffin (2000) did, where they tutor students to use high level of thinking using Biology learning material [30]. Kronberg and Griffin (2000) teach high level of thinking skill through problem analysis to develop critical thinking skill [30]. As a result, students were pleased while learning and students obtained critical thinking skill. It is in accordance with the research conducted by Prajoko (2017) stated that the selection of appropriate learning media will affect student learning outcomes [31]. Cruz (2005), also state that module can help develop skill in scientific process, where there is skill in scientific process there are critical thinking skill [32].

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Think pair share learning module has proven to be able to develop the critical thinking skill of Vocational High School Students. Through the collaboration in small group, students interacted and helped each other, strengthen their understanding together, and draw conclusion from Biology related issue together. Student with poor understanding, improved their understanding with the help of other students who have better understanding. As a result, students have better understanding, explain much clearer, drew conclusion from the issue arise in Biology learning process correctly. The results of this research are strengthened by the research done by Li (2016), where students' knowledge and motivation are improved when learning process are conducted through a module [33].

Biology module of Grade X nursery program Vocational High School with well compiled *think pair share* learning strategy, are proven to improve critical thinking skill. Furthermore, it also provide several benefits such as: (1) it can maximize students' learning process and tutoring process of teachers, (2) students became more proactive during learning process because they are faced with numerous challenge or activities that needed to be completed, (3) provide numerous and quick feedback where students can evaluate their learning results immediately, (4) students' learning effort are more focused because the module provide clear goals, (5) students can learn independently without constricted by teachers, because the prepared learning materials in the module has been set up (Nasution, 2000) [34].

4. Conclusions

Based on results and discussion we can create conclusion as follows.

1) Valid and appropriate product in a form of *think pair share* based Biology module for Biology education in Vocational High School.
2) *Think pair share* based module could improve critical thinking skill with average normalized *gain score* on preliminary field test at 0.77 (high category), main field test at 0.80 (high category), and operational field test at 0.82 (high category).

References

[1] Silva, E. "Measuring skills for 21st-century learning." *Phi Delta Kappan* 90.9 (2009): 630-634.
[2] Voogt, Joke, and Natalie Pareja Roblin. "21st century skills." *Discussienota. Zoetermeer: The Netherlands: Kennisnet* (2010).
[3] McComas, William F. "21st-century skills." *The language of science education*. SensePublishers, 2014. 1-1.
[4] Partnership for 21st centuy skills. "Framework for 21st century learning." Retrieved http://www.p21.org/storage/documents/docs/P21_framework_0816.pdf (2007).
[5] Rotherham, Andrew J., and Daniel T. Willingham. ""21st-Century" Skills." *American Educator* 17 (2010).
[6] Ennis, R. "Critical thinking: Reflection and perspective Part II." *Inquiry: Critical thinking across the Disciplines* 26.2 (2011): 5-19.
[7] Wagner, T. *The Global Achievement Gap: Why Even Our Best Schools DonÕt Teach the New Survival Skills Our Children NeedÑand What We Can Do About It*. Basic Books, 2014.
[8] Duron, Robert, Barbara Limbach, and Wendy Waugh. "Critical thinking framework for any discipline." *International Journal of Teaching and Learning in Higher Education* 17.2 (2006): 160-166.
[9] Permendikbud. "Permendikbud Nomor, P. R. I. 81A Tahun 2013. Tentang Implementasi Kurikulum"(2013).
[10] Anderson, T., et al. "Peer interaction and the learning of critical thinking skills in further education students." *Instructional Science* 29.1 (2001): 1-32.
[11] Maudsley, G., & Strivens, J. "Promoting professional knowledge, experiential learning and critical thinking for medical students." *Medical education*, *34*(7), (2000): 535-544.
[12] Ennis, R.H. "Critical thinking and the curriculum." *National Forum*. Vol. 65. No. 1. Honor Society of Phi Kappa Phi, 1985.
[13] Marzano, R. J. "A Theory-Based Meta-Analysis of Research on Instruction." (1998).
[14] Carin, Arthur A., and Robert B. Sund. *Teaching science through discovery*. Columbus: Merrill, 1985.
[15] Roth, W.M., and Anita, R. "The development of science process skills in authentic contexts." *Journal of Research in Science Teaching* 30.2 (1993): 127-152.
[16] Arnyana, I. B. P. "Pengembangan Perangkat Model Belajar Berdasarkan Masalah Dipandu Strategi Kooperatif serta Pengaruhnya terhadap Kemampuan Berpikir Kritis dan Hasil Belajar Siswa Sekolah Menengah Atas pada Pelajaran Ekosistem." (2004).
[17] Sadia, I. Wayan. "Model pembelajaran yang efektif untuk meningkatkan keterampilan berpikir kritis (suatu persepsi guru)." *Jurnal pendidikan dan pengajaran Undiksha* 2.2 (2008): 19-237.
[18] Prajoko, S. "Profil Mahasiswa Universitas Terbuka Surakarta dan Pemahamannya Tentang Keterampilan Berpikir Kritis." biosel 3.2 (2016).
[19] Chotimah, H. "Peningkatan Proses dan Hasil Belajar Biologi dalam Pendekatan Kontekstual melalui Model Pembelajaran Think Pair Share pada Peserta Didik Kelas X-6 SMA Laboratorium Universitas Negeri Malang." *Jurnal Penelitian Kependidikan* 17.1 (2007).
[20] Suyanik, S. "Pengaruh Penerapan Pola Pemberdayaan Berpikir melalui Pertanyaan (PBMP) dengan Model Pembelajaran Think Pair Share (TPS) dan Strategi ARIAS terhadap Kemampuan Berpikir Kritis dan Hasil Belajar Kognitif pada Siswa Kelas X SMA Laboratorium UM Malang. Tesis." *DISERTASI dan TESIS Program Pascasarjana UM* (2010).
[21] Haerullah, A. "Pengembangan Pertangkat Pembelajaran IPA PBMP dan Think Pair Share pada Sekolah Multietnis dan Pengaruh Penerapannya terhadap Kesadaran Matakognisi, Keterampilan Metakognisi, Kemampuan Berpikir Kritis, dan Sikap Sosial Siswa SD Kota Ternate.(Disertasi)." *DISERTASI dan TESIS Program Pascasarjana UM* (2012).

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[22] Chotimah, H. “Refleksi Implementasi Kurikulum 2013 dan Analisis Kebutuhan Bahan Ajar Biologi SMK se Kota Malang.” Makalah disampaikan pada Seminar & Workshop Nasional Biologi/IPA dan Pembelajarannya di FMIPA Universitas Negeri Malang (2014).
[23] Bachman, Edmund. "Metode belajar berpikir kritis dan inovatif." *Terjemahan Bahrul* (2005).
[24] Hernawan, A. H., Permasih, H., & Dewi, L. (2012). Pengembangan Bahan Ajar.
[25] Depdiknas. “Penulisan Modul. Jakarta: Direktorat Tenaga Kependidikan Ditjen PMTK” (2008).
[26] Borg, W.R & Gall,M.D. “Educational Research: An Introduction (Fourth edition).” New York: Longman (1983).
[27] Hart, D. “Authentic Assessment A. Hand Book for Educators. California New York: Addison-Wesley Publishing Company” (1994).
[28] Permendikbud. “Permendikbud No. 66 Tahun 2013 tentang Standar Penilaian” (2013).
[29] Hake, Richard R. "Analyzing change/gain scores." *Unpublished.[online] URL: http://www. physics. indiana. edu/~ sdi/AnalyzingChange-Gain. pdf* (1999).
[30] Kronberg, Joyce R., and Marshall S. Griffin. "Analysis problems--A means to develop students' critical-thinking skills." *Journal of College Science Teaching* 29.5 (2000): 348.
[31] Prajoko, S. "Pengembangan Perangkat Pembelajaran Praktikum Ipa Berbasis Masalah Menggunakan Bahan Daur Ulang Untuk Meningkatkan Keterampilan Berpikir Kritis, Keterampilan Proses Sains, Dan Sikap Ilmiah Pada Mahasiswa Universitas Terbuka Berkemampuan Akademik Berbeda." *disertasi dan tesis program pascasarjana um* (2017).
[32] Cruz, D., Jose Paulo C. "Development of an experimental science module to improve middle school students’ integrated science process skills." (2015).
[33] Li, Yap Wei. (2016). Transforming Conventional Teaching Classrom to Learner-Centred Teaching Classroom Using Multimedia-Mediated Learning Module. International Journal of Information and Education Technology, Vol. 6, No. 2.
[34] Nasution, S. “*Berbagai pendekatan dalam proses belajar dan mengajar*.” PT. Bina Aksara, 2000.

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