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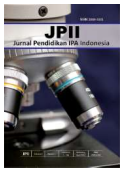

THINKING SKILLS FOR ENVIRONMENTAL SUSTAINABILITY PERSPECTIVE OF NEW STUDENTS OF BIOLOGY EDUCATION DEPARTMENT THROUGH BLENDED PROJECT BASED LEARNING MODEL

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ABSTRACT

This study aims to analyze the difference of thinking skills between treatment (using Blended Project Based Learning Model) and control (non treatment) classes. This is quasi-experimental study of new students of Biology Education as research subject. The thinking skills difference between treatment and control was found out through statistical test of SPSS. The result shows that there is difference of thinking skills (self-regulated, critical, and creative thinking) between treatment and control classes. The mean of self-regulated thinking of treatment class (16.0) is higher than control group (13.4). Meanwhile the mean of critical thinking of treatment class (19.7) is higher than control class (16.7). Therefore the mean of creative thinking of treatment class (14.3) is higher than control class (11.8). Therefore, it can be concluded that the model of Blended Project Based Learning is effective to develop thinking skills of new students of Biology Departement.

Keywords: Biology, Blended, Environmental sustainability, Students, Thinking Skills.

INTRODUCTION

Environmental issues have become a global issue of the countries in the world that must be addressed by all of people (Hartiwiningsih, 2009). Natural resources damage, climate change and global warming in the last few decades, are the adverse effects of human activities on the environment (Khoiriyah & Ristianti, 2012). Environmental problems emerge due to the inability to develop social value system, lifestyles, attitudes, and patterns of thinking with the environment (James & Stapp, 1974).

Build a system of social values, lifestyles, attitudes, and patterns of thinking in order to live in harmony with the environment based on the principle of sustainability is not an easy task (James & Stapp, 1974). At the college level, students today tend to perform unpleasant attitudeof protecting the environment. The lack of good attitude is evident from the increasing of consumptive attitude in keeping the environment (Yanti *et al.,* 2012). The mission of environmental sustainability tends to be left out and ignored.

However, students are part of the resources that should contribute to the advance of civilization. Students should have the sensitivity and concern for the environment. Sensitive and caring attitude of the students towards the environment needs to be grown. Expertise and capabilities need to be improved so that students have the awareness to seek information and to equip themselves with a high scientific capacity so that students have the thinking skills (Susetyarini *et al.,* 2015). Therefore, various attempts at educational level is the right step for building the awareness.

Thinking is all mental activities that help to formulate or solve problems, make decisions, fulfill the desire to understand, search for answers, and achieve of meaning. Using

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thinking skills in a higher level, in the proper context, will train students to improve habit of thinking deeply, and habit of live with intelligent, balanced and accountable approach (Johnson, 2002). High order thinking skill is the ability to use new information or previous knowledge and manipúlate it to reach the possible answers in the new situation (Heong *et al.,* 2011). Thinking constitutes a cognitive process, which is a mental activity for gaining knowledge. Thinking process involves complex, reflective, and creative activities (Andrade, 1999). Thinking is a part of logic, therefore, logical thinking correlates to thinking skill (Husamah & Pantiwati, 2014).

Thinking skills are hard to define but possible to recognize and teach. The list of thinking skills in the UK National Curriculum is a reasonable one and similar to many: information-processing, reasoning, inquiry, creative thinking and evaluation (Costa & Kallick, 2000). Thinking skill is also known as the habit of mind or higher order thinking, and intelligent character trait will appear when people face some problems. It is in line with the idea that critical and intelligent attributes are not merely useful for gaining knowledge but for implementing the knowledge (Wegerif, 2006). The habit of mind is used as a response to unsolve questions and problems. It is activated when individuals encounter unfamiliar problems, uncertainties, questions, or dilemmas. In this case, it is possible that lecturers observe how students produce knowledge than just memorize it (Marzano, 2000).Successful applications of the skills will make students to give valid explanation, decision, performance, and product within the context of available knowledge and experience that promote continued growth in these skills and other intellectual skills (Costa & Kallick, 2000).

The habit of mind identified in the dimensions of learning model consists into three general categories: critical thinking, creative thinking, and self regulated thinking. If you have mental habits that exemplify critical thinking, you tend to a) be accurate and seek accuracy; b) be clear and seek clarity; c) maintain an open mind; d) restrain impulsivity; e) take a position in the required situation, and; f) respond appropriately to others' feelings and level of knowledge. If you have mental habits that exemplify creative thinking, you tend to a) persevere; b) push the limits of your knowledge and abilities; c) generate, trust, and maintain your own standards of evaluation, and, d) generate new ways of viewing a situation that are outside the boundaries of standard conventions. If you have mental habits that exemplify self-regulated thinking, you tend to a) monitor your own thinking; b) plan appropriately; c) identify and use necessary resources; d) respond appropriately to feedback, and e) evaluate the effectiveness of your actions. The list of mental habits reflects the work of educators. However, it is not meant to be an exhaustive list or appropriate list for everyone (Marzano & Pickering, 1997).

The development of thinking skills are needed to prepare students (Nahadi *et al.,* 2014), as it can lead students to direct precision work and thinking in linking something with others with more accurate (Rustaman *et al.,* 2003). Through thinking skills people are able to regulate, adjust, change, or improve his mind so that he can act more precisely. Someone who has the thinking skills will be able to sort out of good thing to do or not, this can be applied to the relationship with the environment (Rasyida *et al.,* 2015). One effort that can be done to instill awareness of protecting and preserving the environment as a form of thinking skills or habits of mind is through the learning process. This step is very effective and has been proven conclusively from the previous studies (Ennis, 1996). The development of thinking skills must be balanced with the attitude that emerges from a person as a result of the learning process. Therefore, in the implementation, the lecturer/ instructor should be able to apply and develop appropriate learning while the learning model that is potential to develop thinking skills of students is project based learning (PjBL).

PjBL is a complex task, it involves students in designing, solving problem, making decision, or investigating activities. PjBL provides an opportunity to work autonomously within a certain period of time and eventually produces tangible products, reports and presentations (Thomas *et al.,* 1999). It also requires to develop skills, such as collaboration and reflection. Referring to the PjBL stages, this model supports thinking skill empowerment, PjBL can improve students' thinking ability (Trowbridge *et al.,* 2004; Husamah & Pantiwati, 2014).

In addition to these considerations, education should be concerned with the integration of information and communication technology in learning (Babateen, 2011), to develop the thinking skills of students. The use of new technologies is often linked to the development of thinking skills or 'higher order thinking' (Costa & Kallick, 2000). Therefore, to apply innovative and active learning methods, the students should be introduced early with information technology-based learning. One of the efforts to improve the quality of learning

is to implement Blended Learning (Husamah, 2014). Blended learning combines the various advantages of conventional learning (face to face), e-learning (online-offline), and mobile learning (Dziuban, 2004).

Based on the theories, I have developed Blended Project Based Learning model (an integrated Project Based Learning or PjBL and Blended learning). This model is implemented in Introduction of Education Course taken by the the first semester students. This study aims to analyze the difference of thinking skills of treatment class (Blended Project Based Learning) and control class (conventional learning).

METHOD

This is a quasi-experimental research, both groups of research subjects were randomly selected by comparing post test scores. This research was conducted at Biology Education Department, Faculty of Teacher Training and Education, University of Muhammadiyah Malang; in the 1st semester class, academic year 2014/2015. The subjects were students who take Introduction of Education course that consisted of 4 classes; IA and IB are treatments class (Blended Project Based Learning). IC and ID as the control class (conventional teaching methods or traditional methods).

Thinking skills was measured by using Thinking Skills Inventory by Marzano (2000) and modified by Husamah & Pantiwati (2014) and Sidharta & Darliana (2005). Thinking skill (or habits of mind) is classified into three categories, of self-regulation thinking, critical thinking, and creative thinking. Self-regulated thinking consists of: (A) being aware of self-thought, (B) making effective plans, (C) being aware and using required information sources, (D) being sensitive on feedback, and (E) evaluating the effectiveness of actions. Critical thinking covers: (F) accuracy and the search for accuracy, (G) clarity and the search for clarity, (H) openness, (I) refraining of impulsive behavior, (J) properly putting themself in certain conditions, and (K) sensitivity and awareness on the ability of peers. Creative thinking includes: (L) ability to engage with asignments, (M) doing an effort by devoting maximum ability and knowledge, (N) designing, using, and revising self-designed evaluation standard, and (O) proposing new ways to view situations from various perspectives (Marzano, 1992; Marzano *et al.,* 1993; Marzano, 2000).

The guideline and questionnaire of thinking skills is presented in Appendix 1. Thinking skill difference of treatment and control class was analysed with One-way ANOVA, processed with the SPSS 22 for Windows software.

RESULT AND DISCUSSION

Three categories of thinking skills that are discussed are critical, creative, and self-regulation thinking. Thinking skills help us to solve problem and make decisions. The more flexible and efficient our thinking, the more effective we will be in our life. Critical thinking is important skill to develop. We are asked to analyze and understand so many things in this very fast-pace world (Ruggiero, 1993). Anderson stated when critical thinking is developed; a person will tend to seek the truth, be open-minded, and be tolerant to new ideas. The person would be able to analyze the problem properly, think systematically, be inquisitive, be mature in, and think critically and independently (Anderson *et al.,* 2015). Critical thinking clearly requires interpretation and evaluation of observation, communication, and other information sources. It also requires skills in thinking about assumptions, in asking relevant questions and interesting implications, in thinking and debating issues continuously (Fisher, 1997).

Creative thinking is skill to develop new and imaginative idea, concept, plan, and other thing that will make people to be valued person and team member. Developing this skill helps us to solve problems better by using creativity. The value of creative thinking is all around us, creative thinking guides us to take risks and step past. The more we practice this skill, the better we get, creative thinking is a tool that can help us and our family (Ruggiero, 1993). Creative thinking style preference is associated with the right brain dominance; while critical thinking was related to the left brain; and those two styles are not thought to be closely related. Left brain style was characterized by information processing in a conceptual and analytical way, and right brain style was characterized by information processing in a direct and synthesis way (Baker *et al.,* 2001)

Self-regulation is an important personality process by which people seeks to exert control over their thought, feeling, impulse, appetite, and task performance. Self-regulation is a highly adaptive, distinctively human trait that enables people to override and alter their responses, including changing themselves so as to live up to social and other standards. Recent evidence indicates that self-regulation often consumes a limited resource, akin to energy or strength, thereby creating a temporary state of ego depletion (Baumeister *et al.,* 2006). Self-regulation is a proactive process

by which individuals consistently organize and manage thoughts, emotions, behaviour, and environment to achieve academic goals (Boekaerts & Corno, 2005). Self-regulation is seen as the interaction between personal, behavioural, and environmental processes (Bandura, 1993).

Blended Project Based Learning model that has been developed is expected to have a positive effect on the thinking skills of students. We have taken the data about the thinking skills (self-regulation thinking, critical thinking, and creative thinking) of students (new students of biology education department), and the result of One-way ANOVA of thinking skills is presented in Table 1, Table 2 and Table 3.

Table 1 shows that mean for critical thinking in treatment class is higher than control class. Mean values of critical thinking in treatment class is 19.74 while the mean values in control class is 16.71. It means that there is difference in the mean value of 3.04. This result shows that the students in the treatment class are better in critical thinking aspect.

Table 3 shows that mean for creative thinking in treatment class is also higher than control class. Mean values of creative thinking in treatment class is 14.32 while the mean values in control class is 11.79. Therefore, there is difference in the mean value of 2.52. This result shows that the students in the treatment class result better in creative thinking aspect.

Table 3 shows that mean for self-regulation thinking in treatment class is higher than control class. Mean values of self-regulation thinking in treatment class is 16.04 while control class' is 13.42. It also can be said that there is difference in the mean value of 2.62. This results shows that the students in the treatment also have better performance in self-regulation thinking aspect.

Based on the data, trend of the thinking skill, as presented in Table 1, 2, and 3, it can be said that the subsequent finding of this study is that if one of the thinking skill components increase or develop, the other components will evolve in a positive way as well. These results are consistent with the results of classroom action research conducted by Husamah and Pantiwati (2014). If one of the thinking skill components is low, then the other components will also be low. This could be seen when the self-regulation was low (58%), the critical thinking and creative thinking were also low (respectively 61% and 58%). Therefore when one of the components increases, the other thinking skill components will also increase (when self-regulation increases up to 68%, the critical thinking is 69% and creative thinking is 68%). If one of the components meets the very good criteria, then the other components also meet the same criteria (when self regulation reaches 84%, critical thinking is 83%, and creative thinking is 82%). In other words, all components of thinking skills are related and influencing one another.

Self-regulation, critical, and creative

Table 1. One-way ANOVAs Result of Critical Thinking

Class	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Treatment class	47	19.74	2.14	0.24	2.36	3.71
Control class	48	16.71	2.36	0.24	2.36	3.71
Total	95					

Table 2. One-way ANOVAs Result of Creative Thinking

Class	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Treatment class	82	14.32	1.34	0.15	1.94	3.11
Control class	92	11.79	2.37	0.25	1.96	3.09
Total	174					

Table 3. One-way ANOVAs Result of Self-regulation

Class	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Treatment class	82	16.04	2.15	0.24	1.98	3.25
Control class	92	13.42	2.10	0.22	1.98	3.25
Total	174					

thinking work together to build habit of mind or thinking skills (Rustaman, 2008). Each component works like a concert, inseparable from each other because they form like a framework that could be used to organize thinking skills. The slices of those three thinking skills also determine the level of someone's self-confidence and personality in facing problems. Thinking skills can be developed together with the learning process so that its performance can be observed during the learning process (Marzano *et al.,* 1993; Rustaman, 2008).

Based on the data it can be said that the treatment class has higher mean value of thinking skills than the control class. Thus it can be said also that the Blended Project Based Learning is effective in improving and developing the thinking skills of new students. Blended Project Based Learning is able to stimulate the three components of thinking skills of self-regulation, critical, and creative thinking.

The positive effects of Blended Project Based Learning on the thinking skills can be explained by many findings and expert opinion. Bell explained that Project-Based Learning (PjBL) is an innovative approach to learning that teaches a multitude of successful critical strategies in the twenty-first century. Students encourage their own learning through inquiry, as well as work collaboratively of research and create projects that reflect their knowledge. From collecting new and viable technology skills, to become proficient communicators and advanced problem solvers, students benefit from this approach to instruction. PjBL is the basis of curriculum, and most projects consist of reading, writing, and mathematics. Many inquiries are science-based or originate from current social problems. The outcome of PjBL is greater understanding of a topic, deeper learning, higher-level reading, and increased motivation to learn. PjBL is a key strategy for creating independent thinkers and learners. Students solve real-world problems by designing their own inquiries, planning their learning, organizing their research, and implementing a multitude of learning strategies. Students develop motivation approach to learn and gain valuable skills that build a strong foundation for their future (Bell, 2010).

PjBL develops students' skills in area of problem-solving, critical thinking, visualizing, decision-making, and reasoning, as well as in written and oral communication. Students engaging in project-based learning process take responsibility for their own learning and become lifelong learners. They also develop better interpersonal and communication skills. Project-based learning recognizes the varied abilities of students, allowing them to draw from their individual strengths to work in areas of their own interest, thus to give them the opportunity to achieve the higher level. Project-based learning consists of active learning and involves students in its activity, so it inspires students to obtain a deeper knowledge of subjects that they study. Research also indicates that students are more likely to retain the knowledge through this approach compared to traditional textbook learning. In addition, students develop confidence and self-direction as they move through both team-based and independent work (Edutopia team, 2008).

Therefore, in order to promote higher-order thinking (thinking skills), contemporary strategies of learning must be used to create challenging activities. During the past decades there has been a significant movement towards blended learning. Blended learning is important in developing thinking concepts and emerges the most prominent delivery mechanism in higher education, hence it is not only the technology that determines the quality of learning. So it is important to define and explain blended learning. Blended learning can be traced as a learning platform where more than one type of learning is applied with optimizing the learning outcomes and cost. An important role of blended learning toward the learners is to develop the educational achievement and thinking skill. This can be achieved by choosing the best media for each tutorial either on the learning management systems or in the classrooms (Sayed, 2013).

Another study shows that there is correlation between the conceptual comprehension and the motivation to learn and discover. In addition, the proposed learning strategy has a great impact in the development of higher-order thinking among learners. Moreover, blended learning plays an important role in linking learning to work and affects the active participation of learners through their cooperation as well as the social interaction. Learners can exchange, analyze and discuss ideas to find solutions of problems and to answer queries and questions asked by teachers (Ahn *et al.,* 2013).

Based on the findings of this study and literature review that has been previously described, integrative model (Blended Project Based Learning) is effective and this can be proven in developing the thinking skills and conceptual comprehension and motivation of students. According to Phan (2010) thinking skills is an important theoretical orientation that

serves to help students' motivation in the teaching and learning processes and develop sensitivity and awareness of their current issues, especially environmental sustainability. The concept of thinking skills emerges from the practice of reflective thinking, where this has been shown to relate students' academic achievement. Thinking skill helps people to think, reflect and analyse their own learning and environmental issues, and to strive and develop expertise in their areas of professionalism.

CONCLUSION

There is difference of thinking skills (self-regulation, critical thinking, and creative thinking) between treatment class and control class. The mean of critical thinking aspect of treatment class (19.74) is higher than control class (16.71). The mean of creative thinking aspect mean of treatment class (14.32) is higher than control class (11.79). The mean of self-regulation thinking aspect of treatment class (16.04) is higher than control class (13.42). It means that the model of Blended Project Based Learning is effective to develop thinking skills of new students of Biology Departement. This model is effective to teach the concept and value about environmental sustainability to Biology Education students.

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Appendix 1 The Grille and Questionnaire of Thinking Skills

Thinking Skills	Aspect	Score
Self Regulated Thinking	A. Realizing Mind Your Own Way	
	Consistent and accurate explain in detail a series of thinking used when faced with a task or problem and provides an analysis of how awareness of his way of thinking was evident from his appearance.	4
	Consistent and accurate explain how to think through tasks or problems and how awareness of the way he thinks it visible and appearance.	3
	Sporadic but accurately explain how to think through tasks or problems and how awareness of the way he thinks it is apparent from the appearance.	2
	Rare but accurately explain how to think through tasks or problems and how awareness of the way he thinks it appears from his appearance.	1
	B. Creating an Effective Plan	
	Consistent make the right destination, consider and take into account all the short-term goals that are considered necessary and make a detailed implementation time.	4
	Consistent making purposes, pay attention to short-term goals, and create a detailed implementation time.	3
	Sporadic making purposes, pay attention to short-term goals, and create a detailed implementation time.	2
	Rarely when working on making purposes, pay attention to short-term goals, and create a detailed implementation time.	1
	C. Realized and Using Resources You Need	
	Consistent display caution, detail to assess the resources required before starting the task. Repeat the resources available and consider alternatives. Anticipating the steps in a task that may be required as an additional source.	4
	Consistent assess the project to identify which parts require resources. Repeats of alternative sources to determine whether it is suitable for the project.	3
	Sporadic assess the project to identify the resources needed for the project, and often look for alternative sources.	2
	Rarely, if carried out to assess the project to identify the necessary resources and often seek alternative sources clear.	1
	D. Against sensitive Feedback	
	Consistent sensitive to diverse feedback. Always respond appropriately when approach deemed does not work well and look for advice and other sources of knowledge.	4
	Consistent attention to the main source of feedback and responses are varied, making adjustments when necessary correction. Listening to the advice of others.	3
	Sometimes noticed the main source of feedback and responses are varied, making adjustments when necessary correction, listen to the advice of others.	2
	Rarely when done, pay attention to the main source of feedback. Rarely respond and make adjustments when necessary corrections. Do not pay attention to the advice of others.	1
	E. Evaluation of Effectiveness Measures	
	Consistent repeat actions that have been done and the things that are considered useful, the evaluation of the impact of measures both short term and long term, finding good value in the lessons of success and failure.	4
	Consistent repeat the action and objective view reasonable, considering the short-term effects, and find lessons in his/her work.	3
	Sporadic repeat the action and objective view reasonable, considering the short-term effects, and find lessons in his/her work.	2
	Rarely repeats the action and objective view reasonable, considering the short-term effects, and find lessons in his/her work.	1

Critical Thinking	F. Accurate and Seek Accuracy	
	Consistent attention to detail where appropriate, match the information on all important resource, recognizing inaccuracies quickly, and make the correction of errors, and clear.	4
	Consistent attention to detail, to test multiple sources, identifies and correct inaccuracies.	3
	Sporadic attention to detail, to test multiple sources, identifies and correct the inaccuracies.	2
	Rarely attention to detail, to test multiple sources, identifies and correct inaccuracies.	1
	G. Clearly and Seek Clarity	
	Consistent creating a complete and free work and confusing elements.	4
	Consistent key element creates jobs free from confusing elements.	3
	Sporadic key element creates jobs free from confusing elements.	2
	Rarely key element creates jobs free from confusing elements.	1
	H. Open-minded	
	Consistent overcome differences and divergent views and to consider alternative viewpoints in a fair and rational.	4
	Consistent aware of different views and always strive to consider alternative views.	3
	When aware of different views and sporadically sought to consider alternative views.	2
	Rarely aware of different views and infrequently seek to consider alternative views.	1
	I. Preventing Properties Impulsive	
	Consistent and carefully consider the situation if it needs further study before doing the work, if necessary, follow-up study, conducted detailed research before doing work.	4
	Consistent consider the situation if it needs further study before doing the work; if necessary, follow-up study, gather enough information before doing work.	3
	Sporadic consider the situation if it needs further study before doing the work; if necessary, further studies, sometimes gather enough information before doing work.	2
	Rarely consider the situation if it needs further study before doing the work; if necessary, follow-up study, did not gather enough information before doing work.	1
	J. Taking Attitude When No Warranty	
	Consistent take appropriate attitude towards the situation, the value of which is displayed and views are not revealed. In addition to providing strong evidence to support its position.	4
	Consistent take appropriate attitude towards the situation and the views were ignored. Always provide enough validation for his/her attitude.	3
	Sporadic take appropriate attitude towards the situation and a clear stance. Sometimes provide enough validation for his/her attitude.	2
	Rarely take appropriate attitude towards the situation and a clear stance. Rarely provide enough validation for his/her attitude.	1
	K. Noting feeling and level of ability of Others	
	Consistent shows insight to the feelings and the level of ability of others that appear when communicating. Always give positive impetus to such differences.	4
	Consistently shows ability to communicate with people of different feelings and knowledge and respect for the feelings, knowledge and abilities of others.	3
	Sporadic demonstrate the ability to communicate with people of different feelings and knowledge and respect for the feelings, knowledge and abilities of others.	2
	Rarely demonstrates the ability to communicate with people of different feelings and knowledge and respect for the feelings, knowledge and abilities of others.	1

Creative Thinking	L. In Constantly seek Completing Tasks Although the answer Could Not Anticipated	
	Consistent shows the seriousness of reaching a solution, get involved. and develop and use many approaches to keep seeking duties	4
	Consistent shows seriousness and approaches to keep seeking tasks.	3
	Sporadic shows seriousness and approaches to keep seeking tasks.	2
	Rarely demonstrates its seriousness and approaches to keep seeking tasks.	1
	M. Encouraging Self-Yourself to Try Something Not Sure Can Do	
	Consistent look for challenging tasks and tasks to complete to complete or to gain significant understanding.	4
	Consistent accept existing challenges and tasks to complete to complete a task or to gain significant understanding.	3
	Sporadic accept existing challenges and tasks to complete to complete or to gain significant understanding.	2
	Rarely accept existing challenges and tasks to complete or to gain significant understanding.	1
	N. Produce, Trusting, and Using Evaluation Standards for Work	
	Consistent generate personal standards for tasks that can raise the level of quality of the task and follow the standard in order to obtain the final product.	4
	Consistent generate personal standards for the task and follow the standard in order to obtain the final product.	3
	Sporadic generate personal standards for the task and follow the standard in order to obtain the final product.	2
	Rarely produces personal standards for the task and follow the standard in order to obtain the final product.	1
	O. Make a New Perspective Unlike the Perspective Generally	
	Consistent explore as many alternatives and resources that enable and analyze how the alternatives affect the results obtained. Alternative describes a variety but a very useful way to look at the situation.	4
	Consistent yield approach to the task and clicking analyzes how these alternatives affect the task. The alternative approach originally created as a student to complete the task.	3
	Sporadic generating approach to the task and clicking analyzes how these alternatives affect the task. The alternative approach originally created as a student to complete the task.	2
	Rarely produce and how to approach the task of analyzing how the alternatives affect the task. The alternative approach originally created as a student to complete the task.	1