Anima, Indonesian Psychological Journal
2012, No. 27, Vol. 3, 143-154

Training Design to Improve Quality of Response: Training to Stimulate Application of Clarity Standard on The Elements of Thinking

Fida Nirmala Nugraha
Faculty of Psychology
University of Padjadjaran

Critical thinking is a must have cognitive characteristics of first year students that enable them to responds to the problems adequately. On the other hand students are rarely having the chance to develop the ability since they are used to get instant results instead of paying attention on the process (Day, 1981; King, Wood, & Mines, 1990). Training that urged students to implement clarity standard on the elements of thinking can stimulate critical thinking. Using randomized pretest posttest control group design, the training is significantly increasing e quality to solve problem amongst subjects. The experimental group has to solve two ill structured problems: one served as pre and posttest, the other is served as a part of problem based learning which both cases force them to applied clarity standard on the elements of thinking. Control group receive only pre and posttest case.

Keywords: critical thinking, clarity standard, elements of thinking, first year students

Kemampuan berpikir kritis merupakan salah satu karakteristik perkembangan kognitif yang harus dikuasai mahasiswa agar dapat memberikan respons yang tepat pada saat menyelesaikan persoalan. Mahasiswa umumnya terbiasa memperoleh hasil secara instan dan kurang memperhatikan proses pencapaian hasil (Day, 1981; King, Wood, & Mines, 1990). Salah satu cara untuk menstimulasi perkembangan kognitif individu dapat dilakukan melalui pelatihan untuk menstimulasi penerapan standar *clarity* pada elemen berpikir. Dengan desain *randomized pretest-posttest control group* yang diikuti subjek, pelatihan secara signifikan dapat meningkatkan kualitas respons yang ditampilkan pada saat menyelesaikan persoalan. Kelompok eksperimen harus menyelesaikan dua persoalan yang ambigu (*ill structured*) yaitu satu persoalan sebagai *pretest* dan *posttest* sedangkan persoalan lainnya merupakan implementasi *problem based learning* yang menuntut subjek kelompok ini untuk menerapkan standar *clarity* pada elemen-elemen berpikir agar dapat memberikan respons yang tepat.

Kata kunci: berpikir kritis, standar *clarity*, elemen berpikir, mahasiswa tahun pertama.

According to Piaget's cognitive development, first year students should have shown critical thinking ability (Berk, 2007**)**, but only around 50% individuals above 12 years of age, including adolescents and adults, who performed formal operational characteristics of thinking (Day, 1981). The cognitive characteristics which are not yet count as formal operational from students of Institut Teknologi Telkom (IT Telkom) are shown from their behavior in class. They tend to rely to the lecturer as a sole provider of information or reading only form handouts instead of searching for them independently by reading the reference books.

Correspondence concerning this article should be addressed to Fida Nirmala Nugraha, Faculty of Psychology University of Padjadjaran. Jl. Raya Bandung Sumedang KM 21, Jatinangor 45363. E-mail: fida_nugraha@yahoo.com.

Observation form one of the Calculus of class of 2010 for half semester, confirmed this less active learning behavior. When it comes to answering the lecturer questions, they answered the questions right away without further consideration of what are being asked and they did not asking any questions to clarify it. This end up with none of the students was able to do the exercise correctly during the lecture on Limit. When the lecturer asking for feedback, which part of the questions that need further elaboration, what things that they do not understand yet, the basic questions reveale: what is the square root of ∞ (infinite), conditions of Limits, and the definition of Limit. The answers to those questions are available on the handouts, reference books and already informed during the class. Since reading form

handouts and sample exercises are the most popular methods that they are using, the results are still far form expected. Most of the students cannot give the appropriate response when confronted with the problem that is similar with the one that is written on the handouts but with different figures. This shows that they merely memorize the answer and not critically analyze the problems. Meanwhile critical thinking is one of the most important abilities that is needed in problem solving (Sternberg & Baron, 1985 as cited in Rollins, 1990, Mayer, 1992, Sumral, 2001, Tümkaya, Aybek, & Aldağ, 2009). Critical thinking is one of the ultimate goal that is seek in learning, especially for students majoring in Telecommunications, Informatics, and Industrial Engineering in IT Telkom (Institut Teknologi Telkom, 2010). Critical thinking basically is a higher level thinking process that involved analysis, synthesis, evaluation. Ennis (1993) define critical thinking as a reasonable reflective mode of thinking that focused upon deciding what to believe or do, Sternberg (1986) said that critical thinking as a mental process, strategy and representations people use to solve problems, make decisions and learn new concepts. Paul & Elder (2002) define critical thinking as a mode of thinking —about any subject, content, or problem—in which the thinker improves the quality of his or her thinking by skillfully taking charge of the structures inherent in thinking and imposing intellectual standards upon them. Within Paul & Elder (2002) concept, the response of those students indicated that they did not apply the clarity standard on the elements of thinking in problem solving.

There are nine standards of thinking: 1) Clarity: is a gateway standard. This standard is focusing on whether a statement is clear/not vague and can be understood correctly. If a statement is unclear, we cannot determine whether it is accurate or relevant. 2) Accuracy*:* a statement may be clear but not accurate. To be accurate is to represent something in accordance with the way it actually is. 3) Precision*:* A statement can be both clear and accurate but not precise. To be precise is to give the details needed for someone to understand exactly what it means 4*)* Relevance: A statement can be clear, accurate, and precise, but not relevant to the question at issue. Something is relevant when it is directly connected with and bears upon the issue at hand. Something is also relevant when it is pertinent or applicable to a problem we are trying to solve. 5) Depth*:* A statement can be clear, accurate, precise, and relevant, but superficial—lacking in depth. We think deeply when we get beneath the surface of an issue or problem, identify the complexities inherent in it, and then deal with those complexities in an intellectually responsible way. 6) Breadth*:* A line of reasoning may be clear, accurate, precise, relevant, and deep, but lack breadth. Sometimes in the argument, one only see from his/her point of view, not comprehensively involved other's. 7) Logicalness*:* When we think, we bring together a variety of thoughts in some order. When the combined thoughts are mutually supporting and make sense in combination, the thinking is logical. 8) Significance: When we reason through issues, we want to concentrate on the most important information (relevant to the issue) in our reasoning and take into account the most important ideas or concepts. 9) Fairness: When we think through problems, we want to make sure that our thinking is justified. To be justified is to think fairly in context. In other words, it is to think in accord with reason. Those standards are hierarchical, before we can master other standards, we have to be able to master clarity standard. These standards of thinking must be applied to the elements of thinking to improve the quality of thinking for a person who will have focus (elements of thinking) to lead the thinking process.

There are 8 elements of thinking: purpose, what is trying to accomplish; *question* need to be asked in order to gain information related to the problem; assumption, identifying what are true based on the evidence and what are merely assumptions relevant to the problem at hand; point of view, which appropriate point of view in order to be able to solve problem adequately; concept, grouping the information that we've had by a specific theory definitions or principles accordance to the problem; information, what kind of information that we need to solve the problem; inferences, form the questions we raised, information we've got, what inferences that we can conclude; considering implication and consequences from the

Tabel 1
Elements of Thinking and Its Primary Standards

Element	Primary standards
Purpose	Clarity, significance, relevance, fairness.
Question	Clarity, precision, significance, relevance, depth
Assumptions	Clarity, fairness, logicalness
Point of view	Clarity, fairness, breadth, relevance
Information	Clarity, relevance, accuracy, fairness, breadth
Concept	Clarity, relevance, depth, accuracy, fairness
Inferences	Clarity, logicalness
Implications and consequences	Clarity, logicalness

Note. Reprinted from Paul, R.W. & Elder, L (2002). Critical thinking: Tools for taking charge of your professional and personal life. Upper Saddle River, New Jersey: Pearson Education Inc.

inferences that are being drawn, are they able to answer the problem appropriately or not. Having applied the clarity standard on the elements of thinking continuously will stimulate the other standards as well (Paul & Elder, 2002; Boardbear, 2003). On every element of thinking there are some primary standards of thinking that applied.

Table 1 shows that clarity standard is the only standard that served as a primary standard on all elements of thinking. If this standard has not been mastered, then it will be hard for the students to master other standards thus this will hinder them to develop critical thinking ability. Thinking ability can be stimulated by imposing clarity standard on the elements of thinking (Walsh & Paul, 1988), through a single program (Feuerstein, Klein & Tannenbaum, 1999; de Bono, 2009; deBonoas cited in Allan (n.d). Realizing the importance of developing thinking ability, a training program was designed to stimulate IT Telkom students on applying clarity standard on the elements of thinking. Training was chosen based on the consideration that any changes on attitude, skills or knowledge can be achieved through learning, but training is any form of process designed to facilitate learning on specific target (Bray, 2006).

Tabel 2
Research Overview

Control Group (CG)	Experimental Group (EG)
Introduction: explanation on background of the research, goals, learning contract, information on the definition of: *critical thinking* (Paul & Elder, 2002), clarity standard, elements of thinking and discussion.	Introduction: explanation on background of the research, goals, learning contract, information on the definition of: *critical thinking* (Paul & Elder, 2002), clarity standard, elements of thinking and discussion.
Ice breaking *Pretest* *Ice breaking*	*Ice breaking* *Pretest*
None Replay slide on the definition of: critical thinking, clarity standard, elements of thinking and discussion.	*Treatment:* Applying the understanding about clarity standard. *Ice breaking* Applying clarity standard on the elements of thinking (PBL, WS 4).
Posttest	*Posttest*

Note. All subjects are equipped with laptop and free Internet access. Prior to the problems are being served, the facilitator trigger them by saying, " Feel free to use all the resources at hand" as a hint to encourage subjects to find all the necessary information needed to be able to solve the problems appropriately. This treatment was also a response to their less active learning study as was explained previously.

Hypothesis

Clarity standard is a prerequia site to master other standards (Paul & Elder, 2002). Application of clarity standard on the elements of thinking can improve the quality of response during problem solving (Broadbear, 2003, Paul & Elder, 2003). Training is one form of process to stimulate the application of clarity standard on the elements of thinking. The research hypothesis is: Quality of response that is shown by students who undergo the training is significantly improved compared to those who did not experience the training.

Method

Randomized Pretest-Posttest Control Group was used in this research with two group of subjects: an experiment and a control group (Graziano & Raulin 2000) (see table 2). The independent variable: training to stimulate the application of clarity standard on the elements of thinking. The dependent variable: quality of response that was shown when facing with problems, the sum of the points from the elements of thinking gained by subjects during pretest/posttest. The total point range from 0 to 24. Assessment of the subjects' quality of response using four scale rubric (0 to 3 point) specially constructed based on critical thinking theory by Paul & Elder (2005, 2002). Three rates were assessed from all subjects on pretest and posttest to minimize bias. Reliability was controlled by conducting intraclass correlation on each problem presented on the training, whilst validity was preserved by expert judgement. Reliability was shown to be high as the intraclass correlation are between .833 to .953 (Johnston, 2000).

Experiment group:

a. Introduction: explanation on background of the research, goals, learning contract, information on the definition of: *critical thinking* (Paul & Elder, 2002), clarity standard, elements of thinking and discussion followed by debriefing.
b. *Ice breaking*.
c. *Pretest* (commercial propaganda about the purity claim from a bottling water company).
d. Activity to analyze three statements which did not met the clarity standard. Subjects have to identify whether or not the statements being presented met the clarity standard, identifying what questions should be raised, asking the right questions to make the previous statements meet the clarity standard, and reformulate the statements that meet the clarity standard.

e. I*ce breaking*.
f. Subjects were divided into seven smaller groups to analyze a popular political problem (a new building for the congressman). Each group was asked to present the results in front of the class. Other groups have to give their responses by asking questions or giving their opinions. This activity is a form of Problem Based Learning (PBL).
g. Facilitator review the process by asking questions that reflect the application of clarity standard on the elements of thinking:
   1. What is the purpose? What were being asked? (purpose)
   2. Was the given information sufficient for you to give the appropriate response? (questions)
   3. Do we need more information? (questions)
   4. What kind of information do you need so you can give the adequate response? (questions)
   5. What can you do if you need more information but that information was not provided to you? (information)
   6. Where can you get the information you need? (information)
   7. Can you find the information you need from a single source? (information)
   8. What other sources are available? (information)
   9. Are there any assumptions that interfere in your thinking during solving the problem? (assumptions)
   10. What concepts were involved? (e.g. main job and responsibility of the congressmen) (concepts)
   11. What point of view that is best suited to see the problem (scientific, politic, or work) (point of view)
   12. What is your response? Can you response to what has been asked? Is the new building a right call? Why? (inferences)
   13. Is it the appropriate response? Why? (consequences)
h. P*osttest*.
i. Closing

Control group:
Subjects of the control group did not expose to activity d, e, f, and g.

Sample

The population was class of 2010 (688 students) from undergraduate majoring in Telecommunication, Informatics, and Industrial Engineering. Stratified random sampling with proportional allocation from Israel (1992) narrowed to 42 samples from those major with the characteristics: students form any of the three majors, 17-18 years of age, minimum IQ 111 (IST). Subjects were from the three majors (see Table 3).

Tabel 3
Sample

No	Major	Control Group	Experimental Group
1.	Telecommunication engineering		
	Male	6	5
	Female	3	2
2.	Industrial engineering		
	Male	5	4
	Female	3	4
3.	Informatics engineering		
	Male	3	4
	Female	1	2
	Sum	21	21

Results

The training that was designed to improve quality of response by applying quality standard on the elements of thinking when facing problems, show a significant result:
a) Mann Whitney non-parametric toward the sum of post-test scores of both groups show that $\alpha = .05$ Because $n > 20$ the formula applied was tak*en* from http://www.alamo.edu/sac/media/puentes/Documentation/CriticalValuesU.pdf.

$$z_U = \frac{\left| U_{stat} - \left(\frac{n_1 n_2}{2}\right)\right|}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}}$$

Note.
Z_U = normal probability U test
U_{stat} = the least value of U1 and U2
n_1 = number of variabel 1 sample
n_2 = number of variabel 2 sample

The calculation results in $U_{stat} = 159{,}5$, $Z_U = -1{,}534$, compared to $Z_{tabel} = 1{,}645$ (table Z from Vernoy & Kyle, 2002), test criteria reject H0 if $Z_U < Z_{tabel}$ which mean that quality of response that is shown by students who undergo the training was significantly improved compared to those who did not experience the training.

Discussion

The improvement of response quality form the subjects of the experiment group is due to the treatment (training). This group was stimulated systematically to apply clarity standard on the elements of thinking through activity d), f), g). Activity d) give the chance to the subjects to apply their understanding on clarity standard. The observation reveals that all the subjects can identified that all three statements did not met the clarity standard, 80% of the subjects were able to raise the important and relevant questions to meet the clarity standard and reformulate the original statements to the new ones that suit clarity standard.

In the next activity (activity f), subjects were facing with ill structured problems in small groups. This activity was a PBL with which subjects have to solve every day's popular problems (covered by media), ambiguous problems that urge them to taking into account the clarity standard and its application to the elements of thinking to solve the problem adequately. During this activity, they get a direct feedback form other fellow subjects and from the facilitator (activity h) to check if their understanding were or were not on the right track. Small groups, and the demand to give opinions or questions to other groups, in activity f) also facilitate the subjects to be independent and active in solving the problem.

Figure 1. show that the average scores of the experimental group subjects was increasing from problem to problem presented in the training. These results also mean that the subjects from this group were more accustomed to apply clarity standard on the elements of thinking. Observation also reveals that despite the increase of the average scores on each problem, the subject still need a reminder, guided with process questions (the questions that reflect the application of clarity standard on the elements of thinking). One popular question was: "does the information presented sufficient for you to answer the question adequately?". Even though they know that it's not, but they still need another "push" to take further action of looking the necessary information. This push is another question such as: " Do you need that information? If the information is not there, what should you do?" Actually this is not a surprise, since

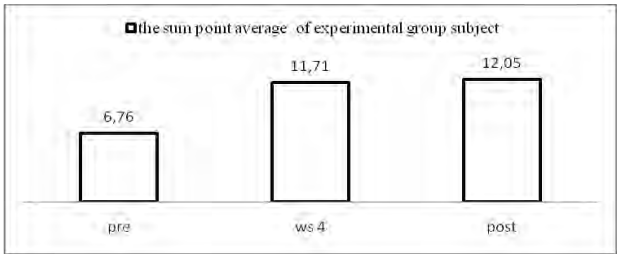

Figure 1. Average scores of experimental group subjects

their learning behavior is less active, they were not accustomed to actively seeking information. Asking questions and giving opinions to the other groups facilitate them to get the right understanding regarding the application of clarity standard on the elements of thinking so they can transfer the knowledge during post-test. The increasing score average shows that transfer of learning had taken place (Perkings & Salomon, 1992). Subjects were able to use knowledge that they got from activity f) that demand the similar principle (application of clarity standard on the elements of thinking) with the problem on the posttest. These same characteristics made the transfer a positive transfer (Ormrod, 2012) whilst the kind of transfer is far transfer because the context of the problem is shifting from politics (activity f) to media propaganda (posttest).

Whilst training is the reason of the increasing average score of the experimental group, the testing effect is the factor that was responsible for the increasing score of the control group. This happens since the pretest and posttest measurement is short (1 hour).

b) Qualitative analysis of the average score on the elements of thinking during pretest and posttest.

Figure 2. shows the average value from both groups on each element of thinking. The average score of elements of thinking are .850952 for control group and .845893 for experimental group. This shows that both groups were on the same conditions during pretest. Mann Whitney test using SPSS 17.0, on the average score confirmed that both group were indeed on the same condition (p value = .875 > α = .05). Those average points were the results from subjects behavior when they were facing problems, and were giving response without making any consideration of the

Tabel 4

Average Scores: Pretest and Posttest

Average score: pretest		Average score: posttest		Wilcoxon test result
Control group	: 6.81	Control group	: 9.57	p value = .00 < á = .05
Experimental	: 6.76	Experimental group	: 12.05	p value = .00 < á = .05

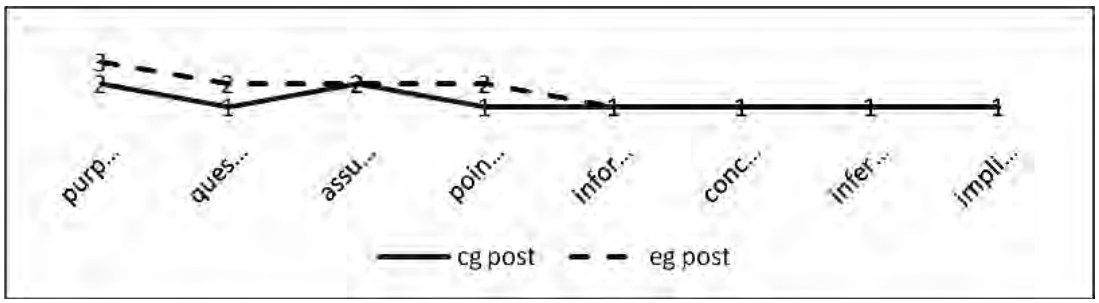

Figure 2. Control group and experimental group posttest profile

elements of thinking. As a consequence they fail to identify the purpose of the problem, thus make their response to other elements of thinking also inappropriate. It takes time to apply new knowledge (clarity standard and elements of thinking), one time encounter on the subject is not enough. It also explains that even though the subjects are, by age, on the formal operational stage but they still show concrete operational characteristics. Each individual can performed formal operational thinking only on the area which they are familiar with and have enough experience on it (Piaget, 1972 as cited in Day, 1981)**.** During the pretest, subjects are still giving response to the elements of thinking partially, not comprehensively looking the elements of thinking as a whole intertwined package to solve the problem. Pretest problem obliged them to consider the following aspects before they were able to give appropriate response:

1. Identify the problem, what does the problem wants (element: *purpose*).
2. Looking the problem from scientific point of view (element: *point of view*).
3. Grouping information into specific concept (e.g. definition of pure water, packaging water purifying technology (element: *information, concepts*).
4. Information that come from asking the right questions in accordance to the purpose (element: *questions*).
5. Identifying any assumptions that influence the inferences (element: *assumptions, inferences*).
6. Considering the effect of the inferences being drawn (element: *implications and consequences)*.

Here are the descriptions of each element from both subjects that show that their responses did not show the application of clarity standard on the elements of thinking during pretest.

Purpose

Appropriate response: determining the truth of the manufacture's claim about the purity of their product (packaged drinking water).

Average value of this element (CG): 1.05
Average value of this element (EG): 1.86

During pretest, the average value gain by control group is lower than the experimental group's on this element. This discrepancies is a result as the control group subjects fail to identify the appropriate purpose of the problem. Instead they come up with unrealistic, contradictory purposes for they tend to give immediate response even though they did not understand what is being asked, yet. This is a mere reflection from their learning behavior when they were responding to the questions given in the Calculus class. As many as 52% of the subjects mention inappropriate response to this element, such as:

1. To increase sales.
2. For promoting the company, to get more people to buy the product.
3. To convince the customer to use the product, escalating profit.
4. To satisfy the customer or to gain wider market share and in the end gaining profit.
5. To earn customers' loyalty of the product.

The experimental subject basically, on average, are more apt to give the appropriate response, only 19% of them who wrote inappropriate ones, such as:

1. Promoting the product via advertisement.
2. To attract customer to buy the product.
3. To preserve cuctomers loyalty.

Questions

Appropriate response: identify the key questions needed to answer the problem (how can you be so sure that the water is as pure as it claims to be? Are there any evidence supporting the claim? What is

the criteria of water purity? What is the standard of water purity? What kind of technology that they actually used?).
Average value of this element (CG): 1.19
Average value of this element (EG): 1.05

All thinking processes have a purpose. The functions of this element is to identify all the important questions that were needed to be answered through the thinking process. Here are things to be considered on this element:

1. Raise the questions according to the problem clearly.
2. Ask questions in several different ways to clarify the purpose and its coverage.
3. Break the questions into smaller ones.

Both subjects are not able to present the appropriate response on this element. Here are some of their responses:

1. Is the information true?
2. What are the sources of that claim?
3. How can we convince the customers to buy the product?
4. Were the customers aware of the product?
5. Are the advertisements able to convince the customer?

Assumptions

Things to keep in mind before giving responses to these elements are:

1. Identifying clearly the assumptions we are using for further validation.
2. Considering how those assumptions affect our perspective during problem solving.

The appropriate answer: identify the assumption(s) that were involved in the problem solving. The main assumptions in this case was that the product is pure because the advertisement said that the product is using pure spring water, using modern packaging technology, and free form hazardous materials.
Average value of this element (CG): 1.43
Average value of this element (EG): 1
Subjects were not able to provide the appropriate response to this element. Here are some of their responses:

1. Most people spend their leisure time by watching TV.
2. When the products reach the customer they were in good condition.
3. Customers are not scientists who were involved in the product research.
4. To prove the claim, customers are the one who should be asked about the product not the company's advertisement.

Point of View

In solving the problem, the thinking process was done within a certain point of view that needs to be considered in responding to these elements:

Table 5
Percentage of Appropriate Response on Control Group: Pretest

		P	Q	A	P o V	Io	C	Ie	I - C
CG pretest	Inappropriate response	95.24%	71.43%	42.86%	90.48%	100.00%	95.24 %	100.00%	95.24%
CG pretest	Appropriate response	4.76%	28.57%	57.14%	9.52%	.00%	4.76%	.00%	4.76%

Note. P=Purpose, Q=Questions, A=Assumption, PoV=Point of View, Io=Information, C=Concept, Ie=Inferences, I-C=Implication and Consequences

Table 6
Percentage of AppropriateResponse of Control Group: Posttest

		P	Q	A	P o V	Io	C	Ie	I - C
CG posttest	Inappropriate response	23.81%	57.14%	47.62%	76.19%	100.00%	80.95%	95.24%	100.00%
CG posttest	Appropriate response	76.19%	42.86%	52.38%	23.81%	0.00%	19.05%	4.76%	0.00%

Note. P=Purpose, Q=Questions, A=Assumption, PoV=Point of View, Io=Information, C=Concept, Ie=Inferences, I-C=Implication and Consequences

1. Identifying the point of view used in relation to the problem at hand.
2. Checking if there are other point of views that are related and explaining the benefits of those point of views.

Subjects' responses to this element are considered to be appropriate if they are able to identify the correct scientific point of view needed to answer the problems in this element.

The average value of this element (CG) : .52
The average value of this element (EG): .86

Subjects of both groups have low average scores on this element. This is caused by the difficulty experienced in identifying the point of view appropriate for the problem. Responses listed below are proof of the said difficulty:

1. Consumers' wish to consume pure and healthy water. It is believed that the process transparency would increase consumers' trust.
2. Positive feedback from the consumers regarding the quality of products using glass brands.
3. The fact that the more consumers know about the benefits of drinking water using glass brands, the more they would be eager to purchase the product.
4. The perspective being used is the point of view of the related drinking water manufacturing company.
5. The fact that the author's personal point of view in solving this problem is as the neutral side. The author is not supporting or acting against the assumption.

Information

In order to ensure that the thinking process being done is valid, the correct supporting information is needed. Several things that need to be considered are:

1. Finding information that supports and also information that challenges the problem at hand
2. Making sure that every information being used are described and stated clearly, precisely, and in accordance to the problem being solved.
3. Making sure that the information obtained is sufficient by adding the source from where the said information was taken from.

Subjects' response to this element are considered to be appropriate if they are able to identity the main information necessary to solve the problem (which were not presented in the problem) and collect information that supports the correct claim.

The average value of this element (CG): .52
The average value of this element (EG): .86

The fact that the average score of subjects from both groups are not optimal yet is mostly caused by the lack of information source.

Concepts

The elements of concepts are elements with the lowest average score compared to the other elements. Concept is the categorizing of ideas, principals, and theories done to group the received information so that the thinking process becomes more structured. Things to be considered when giving response to this element are:

1. Identifying the main concepts being used and explaining it clearly.
2. Considering the possibility of different meanings or interpretations of the related concept.
3. Making sure that the concept is being used carefully and precisely in accordance to the problem at hand.

Subjects' responses to this element are considered to be appropriate if they are able to create a correct definition about the water purity and the criterions of pure water, and also able to define the technology regarding water processing and packaging.

The average value of this element (CG): .43
The average value of this element (EG): .33

Low scores in this element are caused by the two subject groups being unable to identify the main concepts used to solve the problem at hand. This is evident from the responses given in this element:

1. Producing the same level of purity in mineral water products fit for daily consumption of humans.
2. Increasing the sales by fulfilling the consumers' needs, leading in technology as it can make us lead in sales as well, also using the consumer behavioral theory and the manufacturer behavioral theory.
3. Using concepts that are taken from each individual's line of thought.
4. Using the assumption correction theory in order to correct the current assumptions being used.

Inferences

After receiving the information and classifying them to the related concepts, the individual should be able to draw a conclusion or answer the problem at hand. In order to ensure that the right responses are given in this element, the things needed to be taken into account are:

Table 7
Percentage of Appropriate Response on Experimental Group: *Pretest*

		P	Q	A	P o V	Io	C	Ie	I - C
EG pretest	Inappropriate response	95.24%	71.43%	42.86%	90.48%	100.00%	95.24%	100.00%	95.24%
EG pretest	Appropriate response	4.76%	28.57%	57.14%	9.52%	.00%	4.76%	0.00%	4.76%

Table 8
Percentage of Appropriate Response on Experimental Group: Posttest

		P	Q	A	P o V	Io	C	Ie	I - C
EG posttest	Inappropriate response	4.76%	28.57%	38.10%	4.76%	66.67%	52.38%	90.48%	71.43 %
EG posttest	Appropriate response	95.24%	71.43%	61.90%	95.24%	33.33%	47.62%	9.52%	28.57 %

Note.
Inappropriate response = Responses scored as 0 and 1.
Appropriate response = Responses scored as 2 and 3.

1. The conclusions drawn are supported by the relevant information.
2. The conclusions drawn are supportive of the other elements.
3. The assumption used as base for the conclusions are properly considered.

Subjects' responses in this element are expected to be the success of determining whether the claim is valid or otherwise. The inferences should be based on the information subjects have gathered.
The average value of this element (CG): .67
The average value of this element (EG): .86
Examples of responses given by the two subject groups:
1. The drinking water product is fit to be consumed by the general public.
2. Even if the company had done the process as they claimed, it is not necessary that the consumers will trust the company about such claims.
3. The higher the quality of the product, the higher the price of the product will be because of the high technology and investment price.

From the responses above, it can be concluded that the low average score was caused by the fact that the conclusions drawn were not supported or based upon the correct information element as well as the fact that the assumption used was not taken into account.

Implications and Consequences

Subjects' responses in this element are expected to be mentioned of whether the inference is able to solve the problem at hand or not, with a proper reasoning (which consists of relevant information) of the inference.
The average value of this element (CG): .62
The average value of this element (EG): .14

In order to ensure that the conclusion drawn or the answer picked are relevant to the problem's demands, the effects of said answer needs to be considered as well. Several things that needs to be considered when giving response to the implication and consequences element are:
1. Considering the effects from the results of the thinking process, whether the answer or conclusion are able to answer the question or not.
2. Identifying both positive and negative effects of the drawn conclusion from the answers picked in regards to the problem at hand.

Both subject groups were not able to give the correct response but the average score of the control group subjects is higher than the average score of the experiment group subjects. This is caused by the fact that the response given by both groups were not adequate to the problem's demands. Listed below are examples of responses from the experiment group subjects:
1. The effect that appeared in accordance with the wrong conclusion was that sales decreased because of the claims given by the company were not truthful.
2. Consumers did not get any benefits because the purity standard was not the same, causing danger

for the consumers because the product was not fit for human consumption.
3. If the conclusion was right, consumers would believe in the glass brand products. If the conclusion was wrong, consumers would cease to believe in said products.

From the results above it is apparent that both subject groups had the tendency to not consider the thought processes when giving responses. The lack of accuracy of the subjects identifying the goal of the experiment caused the responses in other elements to be inaccurate as well. Subjects did not consider the correct point of view in accordance with the problem's demands. Point of view is the context that helps to see the problem in a certain focus (in this case, the focus is the scientific point of view). This caused the conclusion (or answer) drawn to be inaccurate (not answering the question whether the company's claims regarding their product to be true or false).

It seems that in order to implement the new knowledge regarding the clarity standard definition and thinking process elements in problem solving, quite an amount of time is needed. This means that just one-time experience is not enough for training the clarity standard definition and thinking process elements. In other words when working on the pretest problem, subjects were not used to thinking using a certain point of view or concept (in this case the clarity thinking standards implemented on the thinking ele0ments).

This affects the responses given, being inaccurate in regards to the problem's demands. Melser (2004) explained that thinking is usually related to activities like calculating, pondering, reflecting, and searching for answers. These activities are done to produce something (with a cause) that is used to solve a problem accurately. So that the thinking process become more guided, especially in regards to the goals, the thinking process must be done using a certain frame. According to the critical thinking frame by Paul & Elder (2002), thinking standards and thinking elements are things to be considered.

At the posttest, the control group experienced an increase in their average score and also an increase in the purpose, assumptions, and concepts elements. This is an indication that there is a learning process working during that time (transfer of learning). Meanwhile in the experiment group, the increase of the average score is higher than that in the control group. The increase also happens in almost all elements. This can be explained with the fact that the experiment group had more chance to implement the clarity standard in the thinking elements when they are facing problems, especially the group problem solving activity in question WS 4 (which is an implementation of PBL where PBL is able to develop an individual's thinking abilities according to Bustkist on his 2008 research). This is supportive of the concept by Paul & Elder (2002) that an individual's thinking abilities have to be stimulated continuously to develop.

Subjects in the experiment group is starting to be able to identify the problem's demands correctly and search the needed information (which includes searching for extra information source from the Internet) so that the conclusion drawn is scientifically correct and proven, based on numerous considerations (the consideration that assumptions have an effect on the conclusion drawn being one of them). More experience in implementing the clarity thinking standards on every thinking element has a role on the posttest, increasing the average score of the experiment group higher compared to the control group. The fact that there are scores of thinking elements that have not increased yet in the experiment group shows that the transfer of learning that has happened is not permanent, or in other words not an intellectual trait yet (Paul & Elder, 2002).

During the posttest, experimental subjects scored higher average value (1.504881) in the elements of thinking compared to the control subjects (1.195357). This increase happened because the numbers of inappropriate response from the experimental subjects decreased. Table 5 shows the said decrease in subjects' inappropriate response.

The decrease of inappropriate responses from the experimental group's subjects during test posttest are believed to be caused by the transfer of learning as explained in the earlier section.

Conclusion

The increase in the experiment group subject's average score in each thinking element shows that the training and the general guidelines are correct and have a role in increasing the response quality of IT Telkom students when encountering a problem. Although all subjects' (the control group and the experimental group) quality of response increased significantly during the posttest, the origin of the change was different. In the control group the change is caused by the testing effect and in the experimental group the treatment, or training, was the major factor held responsible.

The cognitive ability (22.5% of which) can be stimulated through structured and systematic activity in train-

ing. As for the rest (77.5%), it is possible to train it using the environment closest to the subject. If the environment places a cognitive ability as important then the subject will place it as equally important and pursue relevant activities in accordance to it (Greenfield, 1976; Shea, 1985; Gauvain, 1998 in Feldman, 2009).

The understanding of clarity standards and thinking elements needs continuous training (by implementing it when dealing with another problem) in daily life (Paul & Elder, 2002), remembering that the understanding about clarity standards and the implementation cannot be mastered with only one-time training. At least with the experience taken from this training, the experiment group subjects have a certain thinking frame when dealing with a problem they encounter, enabling them to give the correct response.

Recommendation for Further Research

Results of this research is only compatible with IT Telkom students of the three faculties from the year 2010. Different results will be drawn from subjects of different faculties, years, and populations. It can be considered for the next research to use a larger sample with more variance to strengthen the result generalization. The use of Solomon's four group design can be taken into consideration as an alternative for the research design to control the effects of interaction between pretest and posttest, or to lessen the effects of confounding variables. The perfection of the rubric scoring through discussion with more experts and raters is also to be considered.

One specific activity should be added to ensure that the subjects are really knowledgeable about the definition of thinking elements. More interesting activites such as games or ice breaking should be carried out to coordinate more interactions between training subjects. The frequencies are also subject to increase in order to avoid boredom. The experience and training to implement clarity thinking standards on each thinking elements should be given continuously so the transfer of learning could be faster, and also to avoid the results of the training expiring quickly.

References

Allan, G. (n.d). *Dr. Edward de Bono's CoRT programme.* Retrieved from http://www.edwdebono.com/cort/debonocort.htm

Berk, L.E. (2007). *Development through the lifespan* (4th ed.). Illinois: Pearson Education, Inc.

Broadbear, J.T., (2003) Essential elements of lessons designed to promote critical thinking. *The Journal of Scholarship of Teaching and Learning 3*(3), 1-8.

Bray, T. (2006). *The training design manual: The complete practical guide to creating effective and successful training programmes*. London: Kogan Page.

Buskist, W. & Iron, J. G.(2008). Simple strategies for teaching your students to think critically. In D.S. Dunn, J.S. Halonen, & R.A. Smith, (Eds.). *Teaching critical thinking in psychology: A handbook of best practices* (pp.49-58). Malden, MA: Wiley-Blackwell

Day, M.C. (1981). *Thinking at Piaget's stage of formal operational*. Association for Supervision and Curriculum Development. Retrieved from http://www.ascd.org/ ASCD/pdf/journals/ed_lead/ el_198110 _day.pdf

DeBono, E. (2009). *CoRT thinking lessons, CoRT 1: Breadth thinking tools, the complete learning, planning, teaching for teachers, administrators, and homeschooler*. USA: The Opportunity Thinker.

Dehghani, M., Sani, H.J., Pakmehr, H., Malekzadeh, A. (2011). Relationship between students' critical thinking and self-efficacy: Beliefs in Ferdowsi University of Mashhad, Iran. *Procedia* (*15*) p.2952-2955. 3rd World Conference on Educational Sciences

Elder, L. & Paul, R. (2007). *A guide for educators to critical thinking competency standards*. Dillon Beach, CA*:* The Foundations for Critical thinking.

Ennis, R.H. (1993). Critical thinking assessment. *Theory Into Practice, 32*(3), 179-186.

Feldman, R.S., 2009, *Development across the lifespan* (5th ed)., Upper Saddle River, NJ: Pearson Education International

Feuerstein, R., Klein, P.S., & Tannenbaum, A.J. (Eds). (1999). *Mediated learning experience: Theoretical, psychosocial, and learning implications*. London: Freund Publishing House.

Graziano, A. M., & Raulin, M. L. (2000). *Research method: A process of inquiry* (4th ed.). Boston: Allyn and Bacon.

Israel, G. D. (1992). *Determining sample size*. University of Florida. IFAS Extention. Retrieved from http://edis.ifas.ufl.edu/pdffiles/PD/PD00600.pdf

Institut Teknologi Telkom. (2010). *Buku pedoman institut teknologi telkom tahun 2010/2011*. Bandung.

Johnston, I. (2000). *I'll give you a definite maybe an introductory handbook on probability, statistics, and excel, section four: Correlation.* Retrieved from http://records.viu.ca/~Johnstoi/maybe/maybe4.htm

King, P.M, Wood, P.K., & Mines, R.A. (1990). Critical thinking among college and graduate students. *The Review of Higher Education 13*(2), 167-186.

Mayer, R.E. (1992). *Thinking, problem solving, and cognition*. New York: Freeman.

Melser, D. (2004) *The act of thinking*. Massachusettes: MIT Press.

Ormrod, J. E. (2012). *Human learning* (6th ed.). Upper Saddle River, NJ: Pearson

Paul, R.W., & Elder, L. (2005). *A guide for educators to critical thinking competency standards.* Dillon Beach, CA: Foundation for Critical Thinking.

Paul, R.W., & Elder, L (2002). *Critical thinking: Tools for taking charge of your professional and personal life.* Upper Saddle River, New Jersey: Pearson Education Inc.

Paul, R.W., & Elder, L (2003). *Critical thinking: Concepts and tools*. Dillon Beach, CA: Foundation for Critical Thinking.

Perkins, D.N., & Salomon, G. (1992). *Transfer of learning.* Contribution to the international encyclopedia of education (2nd ed.). Oxford, UK: Pergamon Press.

Rollins, T.J. (1990). Levels of critical thinking of secondary agricultural students. Pannsylvania State University. *Journal of Agricultural Education 31*(3), 47-53.

Ross, S. M., & Morrison, G. R. (2003). Experimental research methods. In Jonassen, D.H. (Ed.), *Handbook of research for educational communications and technology* (2nd ed.). New Jersey: Lawrence Erlbaum Associates.

Sternberg, R. J. (1986). *Critical thinking: Its nature, measurement, and improvement* National Institute of Education. Retrieved from http://eric.ed.gov/PDFS/ED272882.pdf.

Sumrall, K. (2001). *Critical thinking and problem solving skills (analysis, synthesis, evaluation, decision making, creative thinking)*. Conroe, TX: Montgomery College.

Tümkaya, S., Aybek, B., & Aldağ, H. (2009). *An investigation of university students' critical thinking disposition and perceived problem solving skills.* EJER *36* (Summer).

Tsui, L. (1999, November). *Critical thinking inside college classrooms: Evidence from four institutional case studie*s. Presented at the 24th Annual Meeting of the Association for the Study of Higher Education. San Antonio, TX. Retrieved from ERIC database (ED437013).

Vernoy, M., & Kyle, D.J. (2002). *Behavioral statistics in action* (3rd ed.). Boston, MA: McGraw-Hill Higher Education.

Walsh, D., & Paul, R. (1988), *The goal of critical thinking: Form educational ideal to educational reality*. American Federation of Teachers. Washington, D.C. Retrieved form ERIC database.

Anonymous: Table A5.07 *Critical values for the Wilcoxon/Mann-Whitney test (U).* (n.d). Retrieved from http://math.usask.ca/~laverty/S245/Tables/wmw.pdf.