# Students' Divergent Thinking Ability in Finishing Economics Mathematical Test Using CEM-Learning (C-Learning, E-Learning, M-Learning) at Universitas Pamulang

Nisak Ruwah Ibnatur Husnul[1], Yenny Merinatul Hasanah[2]
[1,2]Pamulang University
E-mail : dosen01267@unpam.ac.id

**ABSTRACT**
This research aims to describe the divergent thinking ability of students in economic mathematics learning through CEM learning (C-learning, E-learning, M-learning) at Universitas Pamulang which supplies blended learning at Accounting Department, Faculty of Economy. The components used to find out the students' ability of divergent thinking are fluency, flexibility, originality, and elaboration. This research applies qualitative approach by using descriptive method. The subjects of this research are accounting students who are taking Economic Mathematics, which uses CEM Learning (c-learning, e-learning, and m-learning) at Universitas Pamulang. The samples are taken by purposive sampling method. The data are taken by giving them Economics Mathematical test, analysing the tests' results, grouping students to be interviewed related to the tests' results. The interview is aimed to clarify the test results related to problem solving the economic mathematics test in divergent thinking. The data are analyzed by using triangulation technique. The findings show that CEM-learning (c-learning, e-learning, and m-learning) in students' initial ability is fairly good. This is proven by the results of economic mathematical test in the, which are in the intermediate level, which was to formulate more than one ways to finish statistical test or problem. However, they were not able to answer on their ways. The components absorbed were fluency, originality, and elaboration.

*Keywords: divergent thinking, CEM-Learning, c-learning, e-learning, m-learning.*

## INTRODUCTION

Challenges in the future always change and the competition becomes tighter. These all require the education outputs, who are not only skilled but also creative in their field respectively. These are essentially manifested in every learning, including in Mathematics. Divergent thinking is a manifestation of higher order thinking. Divergent thinking can be viewed as the ability to think of comparing two or more information, for example the information gained from external environment and the information owned. When there are differences or similarities, she or he is going to question or comment in order to confirm. Critical thinking is frequently related to divergent thinking.

Efforts in increasing the divergent thinking ability to solve problems are really essential in the competitive and global era. This is because all the problems in our lives have been much more complicated (Winter-Simat & Choi, 2017). Divergent thinking ability includes the higher level of thinking. Automatically, divergent thinking ability is the next step from basic competence (Brijlall & Ally, 2016). In Mathematics learning, basic competence is generally known as *basic skill*. Next, convergent thinking is the opposite of divergent thinking. This can be recognized from Mathematics learning activities which use problems which

require structured, systematic, and routine thinking ability. However, critical thinking ability is divergent and it demands activities, which trying to solve problems from various perspectives (Winter-Simat & Choi, 2017). In other words, problem solving is aimed to construct all possibilities to happen instead to find the right answer.

Mathematics learning applied in Indonesia, and even in the world, generally still implements over problems which emphasize on structured, systematic, and routine activities. This is because the aim of Mathematics learning itself still stresses the basic skill (Brijlall & Ally, 2016). However, there is nothing wrong with this. But the rapid changes of nowadays technology are not sufficient to solve the problems in real life (Brijlall & Ally, 2016). In other words, the Mathematics learning should not only stress on the basic skills, but it also has to reach the high mathematics competence.

The explained above perspectives should be made guidance in Mathematics learning in which the models of Mathematics learning are able to provide bigger opportunities to explore their thinking ability to solve problems. Consequently, this new perspective causes new changes on learning activities which stress on the problem-solving. Problem solving does not only focus on how to find the answer, but it also enables the possibility to find the best way to solve problem based on context. This mathematics ability, of course, is really essential for problem-solving in our daily lives (Wood, et al, 2017). Problems faced in this era of technology are not only simple and convergent, but they are also complicated and divergent. Divergent thinking ability is really essential in analyzing, synthesizing, and evaluating all solutions over problems. University students should be directed to reach the higher thinking level by using the information and technology, which rapidly change. Thus, the process of distance learning or e-learning can be maximally executed. Distance learning or e-learning should be prepared in such a way that enables the students to think critically in solving the mathematics problem. Problem-solving should be open or transparent, so the students have chances to solve the problems in various ways (Wood, et al, 2017)

Divergent thinking ability is really important to analyze, synthesize, and evaluate all solutions to problem-solving. Students at universities should be directed to reach the higher level of thinking by utilizing the information technology which rapidly grows recently, so the distance learning process or e-learning and m-learning can be executed maximally. E-learning is the use of internet technology to deliver message or learning content for much broader area. While, m-learning is a learning mobile utilizing information technology and communication.

Lecturers, as the educators, must continuously learn, so they can improve their services for the students. The use of technology and learning requires the ability to master the technology as well as possible. Thus this demands lecturers and students to improve their skills. To answer all challenges in learning above, then there appeared the learning which combines the traditional learning and modern learning, they are c-learning, e-learning, and m-learning (CEM Learning). CEM learning process should be presented in such way, so this can improve the

critical thinking ability in solving mathematics problem. Problem –solving should be open in that it gives solution in more various ways.

Guilford (in Loudon & Deininger, 2016) defines divergent thinking as exploring to various answers, being not embedded into only one possible answer. Still, Guilford (Madore, Jing, & Schacter, 2016) state that divergent thinking refer to the ability in resulting creative ideas by combining various information in a new way. Based on these scholars, it can be concluded that divergent thinking is a process conducted to find more than one solutions over problems (Kowal, 2015).

Divergent thinking can be scored or assessed by using open-ended questions (Loudon & Deininger, 2016). The responses for the questions are assessed regarding to the fluency, originality, and flexibility. Specifically, these three indicators can be outlined consecutively as the accumulation of the uniqueness from ideas and varieties resulted from those ideas (Loudon & Deininger, 2016). Divergent thinking test is conducted by using pscychology approach and it is widely known as creativity indicator (Madore, Jing, & Schacter, 2016). Even, the basic test about creative thinking is related to creativity itself.

Cohean & Swerdlik (2010: 342) state that divergent thinking consists of 4 dimensions, they are: fluency, that is the ability to produce lots of ideas relevant to the problems; flexibility, that is ability to produce new perspectives from various points of views; originality, that is ability to produce new and different ideas or unlike others; and elaboration, that is ability to add various riches or details, both in spoken and in pictures.

However, problems related to the efforts improving divergent thinking in solving mathematics problems face various challenges. One of them is the lack of concepts had by students in solving open mathematics problems. Students still use divergent thinking ability to solve problems when they are having CEM learning. These thoughts have made the writer interesting to review problems on "the students' divergent thinking ability in solving mathematics problems by using cem-learning (c-learning, e-learning, m-learning) in colleges in Jabodetabek". This research aims to find out students' divergent ability in mathematics learning by using cem-learning at Universitas Pamulang which applies blended-learning. The components used to find out students' divergent thinking ability are fluency, flexibility, originality, and elaboration.

## RESEARCH METHOD

This research applies qualitative approach by using descriptive qualititave method. Mukhtar (2013) states "qualitative descriptive research method is a method a researches uses to find out the understanding the interpretation of the existing relations, growing opinion, and on-going process, which is happening or is tending to grow.

The subjects of this research are students of Accounting department taking Economic Mathematics using CEM learning (c-learning, e-learning, and m-learning) at Universitas Pamulang. The samples are picked up using purposive sampling, that is taking samples over personal or researcher consideration.

The techniques used to collect data in this research are by giving test of economic mathematics problem, analazying the result of problem solving, classifying the students into 3 groups (top, middle, and bottom) to be interviewed related test results. The interview is to clarify the test result of problem solving of mathematics test in Statistics course.

According to the indicators of divergent thinking in Table 1, divergent thinking ability of students defined in this research are:

1) students have fluency in thinking if they can provide more than one relevant and obvious ideas;
2) students have flexibility in thinking if they can provide more than one (various) way calculating process but show the correct results;
3) students have originality in thinking if they can answer on their own ways, both the calculation process and the right answer;
4) students have the ability in elaboration thinking if they can provide correct and detail answers.

Table 1. Divergent thinking aspects

| No | Divergent thinking Aspects | Meaning |
|----|---------------------------|---------|
| 1 | *Fluency* | - Students can fluently express various kinds of ideas<br>- Students can fluently and expressively apply words and their associations<br>- Students can produce many ideas relevant to the problems |
| 2 | *Flexibility* | - Students can view a problem from different perspectives.<br>- Students can change their approach and way of thinking when handling a problem<br>- Students can produce various ways for the same correct answers |
| 3 | *Originality* | - students can provide different ideas or ways from the others<br>- students are able to express new and unique ideas |
| 4 | *Elaboration* | - Students can show the answers in details when solving problems<br>- Students can develop ideas and add details in explanation, either by spoken or by picture<br>- Students can draw an implication based on available information |

The technique used to analyze data in this research is triangulation technique. Sugiyono (2015) states that "triangulation technique is defined as techniques used to collect data, which combine various techniques and sources of

data; they are source triangulation, technique triangulation, and time triangulation. This triangulation uses technique triangulation which can be gained by comparing the data of test results of the mathematics problem and interview of test results.

## RESULT AND DISCUSSIONS

In these findings, the students studied are from class of 01SAK009 who are taking CEM learning (C-learning, E-learning, and M-learning). The test results are divided into 3 groups, they are top, middle, and bottom. The results are as follows:

Table 2. Classifications of C-Learning Test Results

| Group | Number of Students | Highest Score | Lowest Score |
|---|---|---|---|
| Top | 7 | 88 | 82 |
| Middle | 24 | 81 | 71 |
| Bottom | 4 | 67 | 55 |

The above Table 2 shows that there are 35 students. 7 (20%) of them belong to top group, 24 (68.57%) belong to middle group, and 4 belong to bottom group. This shows that initial ability of students in 01SAK009 is established enough because most of them (68.57%) belong to the middle group.

Table 3. Classification of E-Learning and M-Learning Test Results

| Group | Number of student | Highest Score | Lowest Schore |
|---|---|---|---|
| Top | 10 | 94 | 85 |
| Middle | 23 | 80 | 74 |
| Bottom | 2 | 65 | 65 |

From Table 3 above we can see that 10 students (28.57%) belong to the top group, 23 (65.71) belong to middle group, and 2 others (5.72%) belong to bottom group. This shows that the initial ability of students in E-learning and M-learning is well enough, because most of them (65.71%) belong to the middle group.

From the test results of c-learning, e-learning, and m-learning, we can see that the better percentage belongs to e-learning. This is because when e-learning is on-going, students have many opportunities and much time to do problems correctly compared to the c-learning which is limited in time. From the CEM-learning results above, it is later picked one representative of each group (top, middle, bottom) to be interviewed deeply related to the test results. After selecting the subject, it is found that there is a student which has the same results in c-learning in the three groups; top, middle, and bottom. Still, it is also found in

the e-learning. These, however, ease the researcher in taking samples in the interviews. Here are the results:

### Subject 1 (Bottom Group)

Subject 1 is the student whose initials is ABD. They haven't had the ability to provide more relevant ideas but resulting the right and clear answer. This can be observed over 2 problems given to them. All problems are solved correctly although the problem-solving does not show various ways. It has not yet shown the ability to provide the right answer in their own ways even though the calculation process and the result are correct. Still, in solving the problems, the students ABD have the right and detailed answers.

### Subjects 2 (Middle Group)

Subject 2 is the student whose initials is FKA, who is a representative of middle group. When planning to finish the problems, FKA stars by compiling one and another idea or problem-solving. Thus, FKA can provide more than one (various) ways. Either the calculation process or result is correct. However, FKA cannot provide answer on her own ways. This means that her answers are the same answer in general. Besides that, in providing the answer, FKA can provide the correct and detailed answer.

### Subject 3 (Top group)

Subject 3 is the student whose initials is RWH, who is the representative of top group in CEM-learning. RWH is able to provide one more relevant ideas in finishing the problems. FKA has various ways of calculating processes and they all result the right answers. RWH starts answering on her/his own ways. Even though her/his ways are not perfect, the answers are correct and detailed.

Based on the 3 above subjects, we can draw a conclusion of divergent thinking ability from the three groups of Accounting students in solving economics mathematics problems as seen in the Table 4 following.

Table 4. Ability in Creative Thinking and Problem Solving the Economics Mathematics Problems.

| No | Aspects of Divergent thinking | Reserch Subjects | | |
|----|----|----|----|----|
| | | **ABD** | **FKA** | **RWH** |
| 1 | *Fluency* | Has not met the indicator requirement of fluency in thinking because he has not yet been able to provide more than one idea to answer | Has already met the indicator of ability in thinking fluently because she has been able to provide more than one ideas in answering the problems. | Has already met the indicator requirement in thinking fluently because he is able to provide more than 1 ideas to answer the problem. |

| | | | | |
|---|---|---|---|---|
| | | problems. | | |
| 2 | *Flexibility* | Has not yet met the requirements for flexible thinking because he cannot solve the problems in different ways even though the answers are correct | Has already met the indicator of flexible thinking because she is able to answer the problems in different ways but the processes and the results are correct. | Has Already met the indicator requirement of flexible thinking because he can solve the problems in different ways and it results the right answers. |
| 3 | *Originality* | Has not yet met the indicator of original thinking because she/he cannot answer on his own ways. | Has not yet met the requirement of original thinking because she cannot answer on his own ways. | Has already met the indicator of original thinking because she/he has tried to answer on his own ways. |
| 4 | *Elaboration* | Has already met the indicator requirement of elaborative thinking because he has answered in correct and detailed ways. | Has already met the indicator requirements of elaborative thinking because she has been able to answer the problems correctly and in details. | Has already met the indicator requirements of elaborative thinking because he has been already able to answer in detail and correct ways. |

## CONCLUSIONS AND SUGGESTION

(1)UNPAM in C-Learning results (20%) in top group, students (68.57%) students in middle group, and the other (11.43%) students in bottom group. This shows that the initial ability of students is quite good, because most of them belong to the middle class, which has already begun to compile more than one idea or method of completion. But not yet able to provide answers in its own ways. (*Fluency, Originality and Elaboration).* (2)UNPAM in E-Learning results 28.57 students in top group, 65.71% students in middle group, and the other 5.72% students in bottom group. This shows that students have the well-established beginning because most of them belong to the middle group, who compile more than one ideas for problem-solving. However, they have not yet been able to answer on their own ways. (*Fluency, Originality dan Elaboration).*

## REFERENCES

Abiola et al. (2015). *Leveraging on E-Learning Platform for Teaching Mathematics in High Schools*. International Journal of Computer Applications (0975 – 8887) Volume 126 – No.6, September 2015, 44-49.

Brijlall, Deonarain & Ally, Noor. (2016). *Transforming traditional mathematics classrooms using e-learning support.* Presented at the DUT 5th learning, teching and assesmet symposium. 9-11 November 2016. Coastlands.

Cohean, R. J. dan Swerdlik, M. E. (2010*). Psychology Testing and Assessment 7th edition*. New York: McGraw-Hill Companies, Inc.

Ghirardini, B. (2011). *E-learning methodologies A guide for designing and developing e- learning courses*. Rome.

Jethro et al. (2012). *E-Learning and Its Effects on Teaching and Learning in a Global Age*. International Journal of Academic Research in Business and Social Sciences, 203 – 210.

Kowal, M. A. (2015). *Cannabis And Creativity: Highly Potent Cannabis Impairs Divergent Thinking In Regular Cannabis Users*. Psychopharmacology , 1123-1134.

Lauricella, Alexis R., Blackwell, Courtney K., & Wartella Ellen. (2016). *The New Technology Environment: The Role Of Content And Context On Learning And Development From Mobile Media.* Media Exposure During Infancy And Earl.

Loudon, G. H., & Deininger, G. M. (2016). *The Pysiological Response during Divergent Thinking*. Journal Of Behavioral And Brain Science, 28-37.

Madore, K. P., Jing, H. G., & Schacter, D. L. (2016*). Divergent Creative Thinking In Young And Older Adults: Extending The Effects Of An Episodic Specificity Induction*. Psychonomic Society, Inc .

Mukhtar. (2013). *Metode Penelitian Deskriftif Kualitatif*. Jakarta : GP Press Group.

Olson, et al (2011). *An Analysis of e-Learning Impacts & Best Practices in Developing Countries*. Michigan State University: Michigan.

Riederer, B. J., & Graef, G. (2005*). Innovation Management-An Overview And Some Best Practices, C-Lab Report, Cooperative Computing And Commucation Laboratory*. Innovation management , 1-58.

Runco, M. A. (1986). *Divergent Thinking And Creative Performance In Gifted And Nongifted Children*. Educational and Psychological Measurement , 375-384.

Sudjana. (2006). *Metode Statistik.* Jakarta: Rineka Cipta.

Sugiyono. (2015). *Statistik Unituk Penelitian.* Bandung : Alfabeta.

Winter-Simat, Nikolas, Wright, Natalie, & Choi, Jaz Hee-jeong. (2017). *Creating 21st Century Global Citizens. A Design-Led Systems Approach To Transformative Secondary Education For Sustainability.* In EAD 12/2017 Design for Next, 12-14 April 2017, Rome, Italy.

Wood D., Lindsay N. J., Gluth S., Corso R., Biisborow C. (2017). *Facilitating Creative Problem Solving In The Marketing Curriculum In Response To The Demands Of The Networked Information. Society*. In : Campbell C.L.

(eds) the customer is not always right? Marketing orientationsin a dynamic business world. Develeopments in marketing science: Proceedings of the academy of marketing science. Springer, Cham.