**The 3rd**
# International Seminar On
# EDUCATION and TECHNOLOGY – ISET
## Collaborative Graduate Schools Conference

# SPATIAL QUOTIENT IMPROVEMENT THROUGH THE DEVELOPMENT OF BRAINSTORMING LEARNING METHOD BASED ON SOFTWARE GRAPHMATICA RESEARCH OPERATION LINEAR PROGRAM

**Abdul Aziz[1*], Iswahyudi Joko Suprayitno[2]**

**[1,2]Universitas Muhammadiyah Semarang , Semarang,Indonesia**

[*]**Corresponding author email: abdoelaziznew@gmail.com**

## Abstract

The aim of this research and development was to know the effect of the brainstorming model based on software graphmatica on spatial quotient research operation linear program. Graphmatica is a tool that plans calculations with numbers and calculus facilities. Combining cartesian chart functions, relationships and equations, parameters, polarization and ordinary differential equations, has about 999 graphs. In addition Graphmatica also has the ability to break the sequence of numbers and display tangent, integral and clear lines. This tool can be applied from secondary school to college. Spatial intelligence is the ability to think someone mengimajinasikan an object in the form of images and space. The development of this product uses a literature study to strengthen the development of a product. This educational product is in the form of Brainstorming learning method and software (software) Graphmatica. Through this stage will examine the scope of Brainstorming and Software Graphmatica methods, the breadth of use, supporting conditions for the product to be used or implemented optimally, and its advantages and limitations. A literature study is also needed to determine the most appropriate steps in the development of the product. In the results of the linear program exam as much as 19 muhammadiyah university students showed good learning outcomes after applying the development of software product graphmatica. This shows that there is an influence in the development of graphmatica software products with the brainstorming model of linear program learning outcomes.

**Keywords:** Spatial Quotient, Brainstorming, Software Graphmatica

## 1. Introduction

In the era of globalization, each country is competing to develop its own potential and resources through strengthening and developing the science of mathematics. Susilo (2012) states that mathematics is a science that has an important role and occupies a core position in the world of science. Operations Research is one of the courses that has a strategic role and is very useful in its application to solve problems related to the world economy, banking, industry and so forth. Based on observations made by researchers, showed that students in studying this material more dititkberatkan on the process of memorizing steps pengerjaannya without understanding more deeply what the benefits of this course if really implemented to solve the problem significantly.

One cause of this is the learning process is still applying the conventional learning method in which the learning process is more dominant one way. Students still partially understand the application of the Operations Research with the subject matter of the Linear Program in the real world. In addition, the students have not been introduced to the development of technology-based learning methods to facilitate their application from a problem to the completion process. Application of learning combined with the use of tools in the form of technology (software) will greatly help students to be able to understand the concept of the material as a whole, because in principle the development of technology-based learning methods made in accordance with the original concept and displayed in an easy to understand.

The hope is that when students are really faced with real problems, the concept will be applied in accordance with the material that has been studied. Graphmatica is a graphical software maker created by k soft, Inc. Graphmatica software has advantages in knowing the position (image) of an equation or linear inequality, quadratic function etc. and its size is relatively small (under one megabyte) and easy to use. Salamat (2013) states that Graphmatica Software can improve students' understanding and learning outcomes in mathematics subjects. The author hopes with the implementation of Graphmatica Software on the learning process will be able to improve the spatial intelligence (spatial quotient) students in learning the subject of linear programming.

### 1.1 Learning achievement

According to D. Gunarso Singgih (2004: 17) learning achievement is the maximum results achieved after

a long time doing a business. From these opinions give some implication that each learning process will affect learning achievement. Relating to the achievement of learning achievement in mathematics education, Tri Widiastuti (2012: 27) reveals that the achievement of learning mathematics is the result that has been achieved by students in following the mathematics lesson which resulted in changes in a student's self in the form of mastery and proficiency shown by the results in the form of value.

## 1.2 Learning Device Development

Research and Development or research and development (R & D) is a powerful research strategy to improve practice (Sutama, 2012). Research and development is a process or steps to develop a new product or refine an existing product and can be borne out. The product can be hardware (hardware) and software (software).

According to Borg and Gall (1989) in Sutama (2012) there are as many steps of the implementation of research and development: 1. Research and information collecting, 2. Planning, 3. Develop preliminary form of product, 4. Preliminary field tasting 5. Main product revision , 6. Main field testing, 7. Operational product revision, 8. Field testing operations, 9. Final product revision, 10. Dissemination and implementation. Broadly speaking, the research and development step by Sukmadinata in Sutama (2012) consists of three stages, namely 1) Preliminary Study; 2) Model Development; And 3) Model Test.

## 1.3 Brainstorming

Brainstorming method which then continued with brainstorming process is result of mix of question and answer and discussion. This method is appropriate as an attempt to collect opinions expressed by all members of the group, may be submitted by one or more persons. Opinions conveyed between one student and another will be different, here the student can proceed to filter which opinions are appropriate through effective and directed communication.

Brainstorming methods can make students become more active in the learning process and able to improve in the ability of mathematical communication. Hari Suderadjat (2004: 44) states that mathematical communication plays an important role in helping students build relationships between informal and intuitive aspects with abstract mathematical language consisting of mathematical symbols and between descriptions and mental images of mathematical ideas

This is also supported by research conducted by Litchfield (2009) which concludes that brainstorming rules will further increase the quantity of opinions that arise if in the process of brainstorming has been set a special goal. Therefore, the role of educator is needed to direct and guide so that learning activities can run well in accordance with its purpose.

## 1.4 Software Graphmatica

Basically Graphmatica is a tool that plans calculations with numbers and calculus facilities. Combining cartesian chart functions, relationships and equations, parameters, polarization and ordinary differential equations, has about 999 graphs. In addition Graphmatica also has the ability to break the sequence of numbers and display tangent, integral and clear lines. This tool can be applied from secondary school to college.

## 1.5 Spatial Quotient

Visual-spatial intelligence is defined as the ability to accurately visualize the visual-spatial world and transform visual-spatial perceptions in various forms (Muhammad, 2012: 16). Spatial visual thinking ability is the ability to think in terms of visualization, drawing and three-dimensional shapes (Sonawat and Gogri, 2008 in Muhammad).

The definition of visual-spatial intelligence according to Muhammad (2012: 88) is the ability to understand images and shapes including the ability to interpret the dimensions of space that can not be seen. Spatial intelligence depends largely on the ability to draw the shape and space of an object, an ability to think of form.

## 2. Methods

2.1 Participants

The samples taken by the researcher are students of mathematics and natural sciences class of 2013/2014 Universitas Muhammadiyah Semarang (UNIMUS).

2.2 Instrument

The results of needs measurement and literature study, not yet strong enough to provide concrete foundations for the development of a product. Both of these studies still need to be complemented by direct research into the field. In the research and development carried out on the students of mathematics and natural sciences University of Muhammadiyah Semarang developed is a method of learning Brainstorming using Graphmatica Software. Researchers conducted field research on some students of statistics Muhammadiyah University of Semarang who also get the same material that is Linear Program Operations Research. In this case, the researcher also collect data about supporting factors and obstacles of learning implementation which include learning facilities and facilities, classroom atmosphere and student activity level.

2.3 Procedures (or research design)

The results of measurement and needs analysis provide input on what kinds of educational products are required in the current learning process. The results of the literature study provide input on some important characteristics of the product to be developed, as well as the form of similar products that have been developed elsewhere. The results of the study in a limited scope provide an overview of embryos and / or similar products that have been used, the implementation of existing products, and possible factors that support and inhibit the use of products to be developed. The product model is still the initial product, which is tentative to be completed through a series of trial activities (Sutama, 2012).

## 3. Results

Based on the results of linear program students of mathematics and natural sciences as many as 19 people showed good value through the development of graphmatica software with brainstorming model. There is a difference in value during the first practice before using graphmatica software product development. There is an increase in value after students can apply linear program material in a product. This is directly proportional to the increase in spatial intelligence that is closely related to linear program material that is more focused on two or three dimensional aspects.

## 4. Discussion

Brainstorming Learning Methods that focus more on students as the subject of education has an important role related to linear program learning outcomes. Teaching Linear program material can use product development that can help students understand the concept and illustrate it in a real context. When a student is able to illustrate the abstract material of a linear program into the context of a dimensionless object it will be able to increase his spatial intelligence.

## 5. Conclusions

Lecturers must be able to apply cooperative and fun learning to explain a material. The material should be contextual so students can more easily understand the lesson. In the process of learning a lecturer should be able to improve multiple intelligences on students one of them spatial intelligence. There needs to be a product development that is useful for students in understanding the abstract context.

## 6. References

IBM Corp. (2012a). *IBM SPSS Statistics for Windows, version 21.0*. Armonk, NY: IBM Corp.

Litchfield, R. C., 2009. *Brainstorming rules as assigned goals: Does brainstorming really improve idea quantity?*. Original Paper. Economics and Business Department, Washington & Jefferson. 33. 25-31. doi: 10.1007/s11031-008-9109-x.

Singgih, D.G. 2004. *Psikologis Praktis, Anak, Remaja dan Keluarga*. Jakarta : BPK Gunung Mulia.

Siregar, Salamat. 2013. *Meningkatkan Pemahaman dan Hasil Belajar Siswa Pada Mata Pelajaran Matematika*

*dengan Menggunakan Software Graphmatica*. Jurnal Pendidikan Matematika. Volume 03 No.1 Hal 55.ISSN : 2088-2157. EDUMATICA.

Suderadjat, H. 2004. *Implementasi Kurikulum Berbasis Kompetensi (KBK)*. Bandung: CV. Cipta Cekas Grafika.

Susilo, F. 2012. *Landasan Matematika*. Yogyakarta: Graha Ilmu

Susilo, F. 2012. *Landasan Matematika*. Yogyakarta: Graha Ilmu.

Sutama. 2012. *Metode Penelitian Pendidikan*. Surakarta: Fairuz Media.

Widiastuti, T. 2012. *Eksperimentasi pembelajaran kooperatif tipe Two Stay Two Stray (TSTS) dan Missouri Mathematics Project (MMP) pada prestasi belajar ditinjau dari sikap sosial siswa*. Tesis UNS. Tidak dipublikasikan.

Yaumi, Muhammad. 2012. *Pembelajaran Berbasis Multiple Intelligences*. Jakarta : PT Dian Rakyat.