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Peningkatan Profesionalisme Guru Melalui Sustainable Pedagogy in Mathematics Education
PROGRAM STUDI PENDIDIKAN MATHEMATIKA FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN UNIVERSITAS SYIAH KUALA

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MELALUI SUSTAINABLE PEDAGOGY IN
MATHEMATICS EDUCATION

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Assalamu'alaikum Wr. Wb.

Tiada ucapan yang lebih pantas disampaikan kecuali puji dan syukur kepada Allah S.W.T, karena hanya atas ridho-Nya kegiatan "Seminar Nasional Pendidikan" sesuai dengan waktu yang direncanakan. Seminar ini akan menjadi kegiatan rutin dimasa yang akan datang (setiap tahun) di FKIP Unsyiah.

Seminar Nasional Pendidikan yang berlangsung di Auditorium FKIP Unsyiah lantai 3 Darussalam Banda Aceh pada tanggal 05 Juni 2014, diselenggarakan atas kerjasama FKIP UNSYIAH. Tema Seminar Nasional Pendidikan adalah "Peningkatan Profesionalisme Guru Melalui Sustainable Pedagogy in Mathematics Education". Dalam acara seminar tersebut panitia mengundang 3 orang keynote speaker yaitu; (1). Prof. Dr. Munirah Ghazali (Universiti Sains Malaysia - Malaysia), (2). Prof. Dr. Fatimah Saleh (Universiti Sains Malaysia - Malaysia), dan (3). Dr. Rahmah Johar, M.Pd. (Pascasarjana Universitas Syiah Kuala - Indonesia)

Pada kesempatan yang baik ini, kami sampaikan terimakasih yang sebesar-besarnya kepada Rektor Unsyiah, Dekan FKIP Unsyiah, para tamu undangan, para donatur, dan seluruh peserta seminar, atas segala partisipasi dan bantuan. Rasa bangga dan terimakasih juga kami sampaikan kepada seluruh anggota panitia yang telah bekerja keras, bahu membahu untuk menyuskeskan acara ini. Akhirnya kami mengucapkan selamat mengikuti seluruh rangkaian seminar, semoga bermanfaat.

Penanggung Jawab Seminar

Ttd

Dra. Suryawati, M.Pd.

Ketua Pelaksana

Ttd

Drs. Bainuddin Yani S., M.Pd.
SAMBUTAN KETUA PROGRAM STUDI PENDIDIKAN MATEMATIKA
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN
UNIVERSITAS SYIAH KUALA
DARUSSALAM, BANDA ACEH

Assalamu’alaikum Wr. Wb.


Saya selaku ketua program studi begitu gembiranya melihat antusias para panitia dan para praktisi matematika, para alumni dan sarjana matematika dari berbagai instansi beserta partisipasi dari gabungan beberapa jurusan PPG SM-3T yang ikut ambil bagian dalam mensukseskan acara Seminar Nasional Pendidikan Matematika (SemNaspemMat 2014).

Penelitian dan pengembangan yang terkait dengan dunia pendidikan harus terus digalakkan dan dikomunikasikan kepada semua stakeholder. Karenanya, upaya mengundang keynotespeaker, baik dari tingkat internasional dan nasional pun kami tempuh untuk menyemarakkan Seminar Nasional ini.

Pada kesempatan ini saya juga menyampaikan ucapan terimakasih kepada; Rektor Unsyiah yang telah memberikan arahan dan berkenan membuka seminar ini; Bapak Dekan FKIP Unsyiah, Ibnu Prof. Dr. Munirah Ghazali, Ibnu Prof. Dr. Fatimah Saleh, dan Ibnu Dr. Rahmah Johar, M.Pd. sebagai keynotespeaker pada seminar ini. Saya mengucapkan terimakasih dan penghargaan yang setinggi-tingginya kepada penyelenggara dan seluruh panitia yang terlibat dalam merancang kegiatan tersebut, atas upaya kreatif yang cukup mendasar sehingga pelaksanaannya cukup mengesankan.

Demikianlah sambutan saya, mudah-mudahan Seminar Nasional Pendidikan Matematika kali ini berjalan dengan baik dan lancar serta memberikan pemikiran-pemikiran segar bagi upaya peningkatan mutu pendidikan di Aceh.

Wassalamu’alaikum Wr. Wb.

Ketua Program Studi
Matematika FKIP Unsyiah
Ttd

Dra. Suryawati, M. Pd.
DAFTAR ISI

A. KATA PENGANTAR

PEMAKALAH SESI STADIUM GENERAL

SUSTAINABLE PEDAGOGY IN MATHEMATICS EDUCATION
Munirah Ghazali

SUSTAINABLE PEDAGOGY IN MATHEMATICS EDUCATION
Fatinah Saleh

MODEL PEMBELAJARAN BERDASARKAN KURIKULUM 2013 UNTUK MENGEMBANGKAN KOMPETENSI MATEMATIKA DAN KARAKTER SISWA
Rahmah Johar

PEMAKALAH SESI PARALEL

IDENTIFIKASI SCAFFOLDING GURU MATEMATIKA MENUJU PELAKSANAAN KURIKULUM 2013
Anwar Ramli, Ipung Yuwono, Edy Bambang

KECERDASAN TRIANGLE SEMPURNA PADA PENERAPAN DESAIN MAKET MATEMATIKA (MAMA) DI PEGURUAN TINGGI PADA MATA KULIAH WORKSHOP MATEMATIKA
Ariyani Muljo

ANALISIS FAKTOR KESULITAN GURU PPL MENGELOLA KELAS DALAM PEMBELAJARAN MATEMATIKA DI SMA SE-KOTA LANGSA
Budi Irwansyah

HAL
1
16
25
38
47
56
KESALAHAN SISWA MAN MODEL BANDA ACEH DALAM MENYELESAIKAN SOAL-SOAL FUNGSI
Budiman, Rahmat Fitra, M. Hasbi 66

PENERAPAN PENDEKATAN KONTEKSTUAL (CTL) PADA MATERI SEGIEMPAT DI KELAS VII SMP NEGERI 1 BANDA ACEH Dhelsy Naikriaisyah Azna, Erni Maidiyah, Usman 74

PENGARUH KECERDASAN EMOSIONAL TERHADAP PRESTASI BELAJAR MATEMATIKA SISWA DI KELAS X SMA NEGERI MODAL BANGSA Elsa Rahmah, Erni Maidiyah, Johan Yusuf 81

MENINGKATKAN PENALARAN GEOMETRI SPASIAL SISWA DALAM PEMBELAJARAN BANGUN RUANG DI SEKOLAH MENENGAH ATAS Khairul Umam, Suryawati, M. Hasbi, dan Juanda BJ 91

TINGKAT BERPIKIR DAN KESULITAN SISWA PADA MATERI TRIGONOMETRI DI KELAS XI SMA LABORATORIUM UNSYIAH BANDA ACEH TAHUN PELAJARAN 2013/2014 Intan Sari, Suryawati 96

KEMAMPUAN BERPIKIR TINGKAT TINGGI MELALUI METODE PENEMUAN PADA MATERI LUAS PERMUKAAN BANGUN RUANG SISI LENGGUNG SISWA KELAS IX SMP NEGERI 18 BANDA ACEH Laila Zuriatina, Baimuddin Yani, Tuti Zubaidah 105

MOTIVASI SISWA DALAM PEMBELAJARAN UNSUR-UNSUR KUBUS MELALUI PENELAPAN MODEL PEMBELAJARAN QUANTUM TEACHING DI KELAS VIII MTNSK LAMBALEK KABUPATEN ACEH BARAT Listika Burais 114
PENERAPAN MODEL KOOPERATIF TIPE BERKIRIM SALAM DAN SOAL PADA MATERI TURUNAN FUNGSI DI KELAS XI SMA LABORATORIUM UNSYIAH BANDA ACEH
Ellianti, Marhani

ANALISIS KEMAMPUAN REPRESENTASI MATEMATIS SISWA PADA MATERI PERTIDAKSAMAAN LINEAR SATU VARIABEL DI KELAS VII SMP NEGERI 6 BANDA ACEH
Mila Rahmadina, Johan Yunus, Rahmah Johar

PENGEMBANGAN PORTOFOLIO ASSESSMENT PADA PEMBELAJARAN MATA KULIAH GIOMETRI PGSD : PEGANGAN GURU
Murni, Burhanuddin AG

KORELASI ANTARA NILAI MATEMATIKA DENGAN EKONOMI PADA SISWA KELAS X MAN MODEL BANDA ACEH TAHUN PELAJARAN 2013/2014
Musafr Kumar, Bintang Zaura, Emilia Maihisa

MEMINIMALIKAN KESULITAN BELAJAR MATERI PERSAMAAN GARIS LURUS PADA SISWA KELAS VIII 3 SMP NEGERI 16 BANDA ACEH DENGAN PENDEKATAN KONSTRUKTIVIS
Niwati

PENGUNGAAN ALAT PERAGA BEKAS UNTUK MENINGKATKAN AKTIVITAS DAN HASIL BELAJAR PEMERATA DIDIK KELAS VIII-1 SMP NEGERI 7 BANDA ACEH PADA MATERI LUAS PERMUKAAN PRISMA DAN LIMAS TEGAK
Qadarusmi
PENERAPAN MODEL DISCOVERY LEARNING UNTUK MENINGkatkan pemahaman konsep siswa pada pokok bahasan permutasi di kelas X MAN ULMU KABUPATEN PIDIE JAYA
Rohmawati

PENERAPAN MODEL DISCOVERY LEARNING UNTUK MENINGkatkan pemahaman dan motivasi belajar matematika siswa di kelas X-3 MA DARUL ULMU BANDA ACEH
Rohmaazatulaili

PENERAPAN MODEL PEMBELAJARAN GENERATIF LEARNING PADA MATERI TRIGONOMETRI DI KELAS X SMAN 4 BANDA ACEH TAHUN PELAJARAN 2012/2013
Ellianti, Rahmi Maulina, M. Iahir

ASPEK SIKAP MAHASISWA PENDIDIKAN MATEMATIKA TERHADAP PELAKSANAAN PERKULIAHAN SEJARAH MATEMATIKA
R. M. Bambang S. Utman, Rahmat Fitra

PENERAPAN MODEL KOLB'S LEARNING STYLE (KLS) DALAM MENINGkatkan hasil belajar matematika materi lingkaran kelas VIII semester II di SMP NEGERI 16 BANDA ACEH TAHUN PELAJARAN 2009/2010
Siti Nurbaya

PENDEKATAN PEMBELAJARAN INDUCTIF PADA MATERI BANGUN RUANG PRISMA DAN LIMAS DI MTSN RUROH TAHUN PELAJARAN 2013/2014
Sri Wahyuni, R. M. Bambang S. Musafir Kuner
IMPLEMENTASI MODEL POLYA PADA PEMBELAJARAN
MATEMATIKA DI PRODI PKK FKIP UNIVERSITAS SYIAH KUALA
BANDA ACEH
Subartati

PEMBELAJARAN DISCOVERY LEARNING PADA MATERI ATURAN
PENJUMLAHAN REEMAN DI SMAN 11 BANDA ACEH
Tien Safrina

PEMBELAJARAN MATHEMATIKA DENGAN HYPNO-TEACHING DI
KELAS VIII SMP PLUS AL-ATHIYAH ACEH BESAR
Yuhasriati, Agam Mustafa

PEMBUATAN APLIKASI KARTU ALJABAR DIGITAL
Zul Firdaus Mustafa, Jovita
Background of study

The concept of spatial thinking is very interesting to discuss. Spatial thinking is an active process in which the elements about think and act in a space that tied (Claire H. Jarvis, 2011). Spatial thinking is a collection of cognitive skills, which consists: a combination of three elements, namely spatial concepts, tools of representation, and reasoning processes (National Academy of Science, 2006). To understand the detail of three-dimensional object properly, someone must have a spatial ability. But not everyone has the good spatial ability, even among them there is no way to recognize the longer form of the three-dimensional shape of the object if the same three-dimensional images drawn from different angles of 3D problems, many students difficulty to grasp objects or geometry images.

Spatial ability is a concept in spatial thinking. Linn and Petersen (the National Academy of Science, 2006) classify spatial capabilities into three categories: (1) spatial perception, (2) mental rotation, and (3) spatial visualization. Viewed in the context of mathematics especially geometry, it is very important for the spatial abilities improved, it is referring to the results of research conducted by the (National Academy of Science, 2006), in this study stated that every student should strive to develop skills and spatial sensing, it is very useful in the discussion of the relation and the properties of the geometry in solving mathematical problems and problems in everyday life.

(Hannafin, et al, 2008) found that students with high spatial ability has a level significantly higher math skills.

In a study conducted by (Nuran Guzel and Ersin Sener, 2009), this research was conducted to see "High school students spatial ability and creativity in geometry", the purpose of this study was to investigate the potential of high creativity and low spatial ability students in geometry.

This study was conducted among 145 grade 10, 11, and 12 students during mathematics and geometry courses in high school and the application of research has three phases. This study took place at two high schools and two high schools Anatolia, 30 Biga Ataturk Anatolian High School (RAAL), 49 Eiga Anatolian High School (BAL), 23, Mehmet Akif Ersoy High School (Maet), and 23 New Biga High School (YBL).

The first part of this study consisted of three questions geometry in the range from easy to difficult. Students were given three different time periods to answer every question that are: easy, very easy, and difficult. Students are supposed to solve the question "very easy" within 5 minutes, the question of "easy" in 7 minutes, and the question of "difficult" in 8 minutes and they were supposed to produce a different way for each solution as many questions as they can. Each question in this application is governed in a way that students can imagine a different way of solution in their mind while solving the question.

In the second phase of the study, a survey with 6 questions applied. This survey is proposed to examine students' views about mathematics and mathematics questions, and the different paths they use to solve the questions. The students were asked to answer questions by selecting the appropriate option from the following options: 1: Strongly Agree, 2: Agree, 3: Disagree, 4: Strongly Disagree.

The final stage of the study, the test consists of 20 questions that applied to students in order to measure the level of students' spatial abilities. Time range for this test is 20 minutes. This test is designed to see how well students are able to visualize the rotation of three-dimensional objects. There are the examples of questions in the beginning of the test. In each question, first, the students should understand how the objects in the playing. Then, students must draw in their mind about how the objects in the second line
will look like when played in the same way as it is in the top row. Finally, students were asked to select an object that is given in the third row who looks like a rotated version of the object in the second row in the correct position based on the pattern in the first row. Each question is mutually exclusive and have 5 choices.

On the results of the study, Table 1 shows the average number of different solution methods for geometry questions based on Spatial Ability.

<table>
<thead>
<tr>
<th>Ability</th>
<th>Geometry Question 1</th>
<th>Geometry Question 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower ability</td>
<td>54</td>
<td>3.0*</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Higher ability</td>
<td>91</td>
<td>3.4*</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*p<0.05

Students who got higher score on spatial abilities of 1.1 is encoded as high spatial ability students, whereas students with the ability score equal to or lower than 1.1 are coded as low spatial ability students. The high spatial ability students are more able to find a different method than the lower group.

Table 2 One-way ANOVA on mathematics test scores, scores geometry, algebra scores, statistics and probability and arithmetic scores.

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td>414.3</td>
<td>3</td>
<td>138.1</td>
<td>11.6*</td>
</tr>
<tr>
<td>Within</td>
<td>1675.8</td>
<td>141</td>
<td>11.8</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2090.2</td>
<td>144</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The findings were no significant differences between schools based on students' spatial ability. (F = 11.6; df = 3, 144, p = 0.0). Students in BAAL have higher spatial ability than any other school students. As a result, students in BAAL have found more one methods question compared with other school students.

In a study (Aytaç Kurtulu and Canda Uygan, 2019) entitled "Effect of Google SketchUp in geometry-based activities and projects on students' spatial visualization skills of mathematics teachers", the study aimed to determine the effect on the SketchUp geometry-based activities and projects in students' spatial visualization skills math teacher, this is an experimental research model pretest-posttest design with a control group. Both of the two groups, including twenty-four each student math teacher. To obtain the data, Santa Barbara solid test designed by Cohen and Hagarty to measure the ability to identify cross-sectional 2D slices of 3D objects used (Picture 1).

![Picture 1: sample from santa barbara solid test](image)

In the instruction of the experimental group, activity-based problems are solved by using dynamic tools and project studies done on SketchUp environment while the activities of traditional geometry applied to the control group using only paper and pencil. Before instruction, the researchers introduce the basic tools and demonstrate the use of software for the experimental group. After that, the students made a practice in software to gain experience on how to use the toolbar and build the base object. Next lesson
students solve the problem of solid objects by manipulating and analyzing simulation of 3D objects in a dynamic environment. SketchUp on this lesson gives students the same opportunity as the sketch, rotate and cut solid objects. On the other hand, the control group solved the same problem on paper without getting help from a computer or printer. In the research project, the first experimental group designed building has a different geometric shapes and complex in SketchUp, then measured their surface area and volume using software measurement tools and redrawing the surface of a particular point of view on their own paper. At the end of the lesson, the students in the experimental group made a virtual presentation of their products to researchers (Picture 2).

![Picture 2: The sample from students](image)

To reveal whether there are significant differences between the experimental group pretest scores and the control group, Mann Whitney U test applied to the data. Analyzing the results gathered in tabel.3 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>(\bar{x})</th>
<th>S.D.</th>
<th>Z</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>24</td>
<td>13.375</td>
<td>6.092</td>
<td>-0.052</td>
<td>0.959</td>
</tr>
<tr>
<td>Control Group</td>
<td>24</td>
<td>13.416</td>
<td>4.624</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P > 0.05

Tabel.3: Results of Mann Whitney U test on pretest scores the experimental group and the control group.

According tabel.3, the average score of the control group rate was 0.041 points higher than the control group and the standard deviation of the experimental and control groups, respectively 6.092 and 4.624. In addition, Z is calculated as -0.052 degrees while the degree of significance p was found to be 0.756. Due to the fact that the significance level p was higher than 0.05, it is seen that the difference between the mean value of the two groups were not significant.

In order to determine if the difference between pretest and posttest score of the experimental group were significant, Wilcoxon test used and the findings presented at tabel.4 out below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>(\bar{x})</th>
<th>S.D.</th>
<th>Z</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>24</td>
<td>13.375</td>
<td>6.092</td>
<td>-2.704</td>
<td>0.007</td>
</tr>
<tr>
<td>Posttest</td>
<td>24</td>
<td>18.833</td>
<td>6.162</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P < 0.05

Tabel.4: Wilcoxon’s test results on the value of the experimental group pretest and posttest.

In reference to tabel.4, it is clear that the average posttest score 5.468 points higher than the average pretest score. Also, the standard deviation of the pretest and posttest scores was found to be respectively 6.092 and 6.162. In addition to that title Z detected as -2.704 and significance level p was found to be 0.007. Seeing that a significant level of p less than 0.05, there is a significant difference between pretest and posttest scores in favor of posttest scores.
So, to see if there is a significant difference between pretest and posttest score of the control group, the Wilcoxon test is applied again. Table 5 below shows the test results.

<table>
<thead>
<tr>
<th>Control Group</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>S.D.</th>
<th>Z</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>24</td>
<td>13.416</td>
<td>4.624</td>
<td>-1.570</td>
<td>0.116</td>
</tr>
<tr>
<td>Posttest</td>
<td>24</td>
<td>15.875</td>
<td>4.730</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P > 0.05

| Table 5: Wilcoxon's test results on the value of the pretest and posttest control group |

Such as table 5, standard deviation scores pretest and posttest respectively 4.624 and 4.730. Also the t-value of $Z$ is calculated as -1.570 and significance of $p$ is detected as 0.116 degrees. Because $p$ value is significantly higher than 0.05, the difference in points between 2.359 as the average posttest score and the average value was not significant pretest scores.

In an attempt to see if there is a significant difference between the posttest score of the experimental group and the control group, Mann Whitney U test performed on the data. The finding seen in Table 6 below:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>$\bar{X}$</th>
<th>S.D.</th>
<th>Z</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>24</td>
<td>18.833</td>
<td>6.162</td>
<td>-2.244</td>
<td>0.025</td>
</tr>
<tr>
<td>Control Group</td>
<td>24</td>
<td>15.875</td>
<td>4.730</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P < 0.05

| Table 6: Results of Mann Whitney U test on the posttest score of the experimental group and the control group |

According Table 6, the average value of the experimental group posttest score is 3.042 points higher than the control group. In addition, the standard deviation of the experimental group was found to be 6.162 while the standard deviation of the control group was calculated as 4.730. It is also clear that the degree and significance $Z$ is -2.244 degrees and $p$ is 0.025, lower than 0.05. So it was determined that a significant difference between the posttest scores in favor of the experimental group.

According to the findings, and project-based activities SketchUp affect spatial visualization skills. Confirmed positive student math skills. It can be concluded 2D slices of 3D objects. On the other hand, that the conventional applications where static tools examples of paper, board and used two-dimensional images do not provide a significant effect on students' spatial visualization abilities. Results in the context of SketchUp can be used as well as beneficial for improving students' spatial abilities. And, the results of using the software more effectively in a dynamic 3D spatial abilities than using conventional media.

From this background the author wants to do research at Senior High School to find appropriate methods and media and is ideal for use in conducting learning.

**The Objective of the Study**
1. Seeing the students' understanding the spatial understanding/mastering geometry objects.
2. Improve spatial understanding of students in understanding the geometry with the help of Google SketchUp software media in learning.
3. Comparing the level of spatial's understanding and the ability of students to solve problems in the geometry of three-dimensional materials that use Google SketchUp software media with the use of conventional media.
4. Students' ability in understand the content, form, and rotation of geometrical objects.

**Methodology of the Research**
The following are the steps that will be used to conduct this research,
1. Randomly select two Senior high school level which is the object of research.
2. Perform pre-test to students in some classes in order to find two homogeneous classes of each school to be the object of research.
3. From the two classes are the object of research will be considered each experimental class and the control class.
4. Experimental class will use the media software as a learning tool in doing.
5. Control class still use conventional media in doing the learning.
6. Assess and perform data processing of the sample assessment to get the results that students become the object of the study has good spatial geometry capabilities or not.
7. Furthermore find the best solution by using computer programming to create the most suitable media and is ideal for teachers or students in the learning process by increasing teacher performance and student learning outcomes in the classroom.

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Date: 5 June 2014

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Jointly organized by:
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Organizer

Baiduddin Yuni, S., MPd.