Digital measurement of student learning style: Using smartphones for self-evaluation

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Abstract. Students had different characteristics of learning styles, differences from these characteristics can affect learning achievement, confidence, communication, and other activities. This study aims to analyze student learning achievement with all three learning styles. The method in this study is a quantitative method and continued with analysis. The data of this study were obtained from all junior high school students at Karanganyar, Indonesia, district and used multiple choice question test instruments and questionnaires. The results of this study indicated that student learning achievements have differences from learning styles. To improve learning achievement, in mathematics learning students are trained to work on math problems and the teacher expected to know student learning styles so that the teacher can provide appropriate to handle students at Karanganyar Regency.

1. Introduction
Education is a universal activity in human life surround the world wherever and whenever must have an education. The essence of education is to humanize humans themselves. Educating was directed at humans to develop potentials of human to be the real one. In the development of education in Indonesia, it is important to note that education will be succeeded by maximalize in every element of education and the purpose of education.

In accordance Undang-undang No. 20 tahun 2003 that the purpose of national education functions to develop capabilities and to form a dignified character and national civilization in order to educate the nation's life, aims to develop the potential of students to become human beings who believe and fear God Almighty, noble, healthy, knowledgeable, competent, creative, independent, and a democratic and responsible citizen [1]. To realize what is in the goals of national education, the government has made many changes and improvements to the education system in terms of policies and curriculum.

Curriculum 2013 was developing by the government. This curriculum had a purpose to revise the learning in formal education. As a revise for the previous curriculum, the evaluation has been done in all aspect. Evaluation for the students was not only by the score in the examination but also politeness, religious, practice, attitude and others so that this curriculum showed all of the dominant aspects of attitude, skill, and knowledge of the students. the one of focus study in increasing of quality of education was done by the government in the mathematics study.

Mathematics is one of the useful basic sciences. Every science is never separated from mathematics. Mastery of mathematics would be very helpful in following science and technology which is growing rapidly in this modern age. The aim of mathematics at the elementary and secondary education level
was to emphasize the formation of personality attitudes of students in order to be able to use mathematics in their lives. Thus, mathematics became a very important subject in education and must be studied at every level of education.

In general, students from various levels of education had difficulty in learning such as applying formulas and solving mathematics’ questions. This atmosphere had an impact on students’ low achievement on mathematics subjects and the result have not been as expected.

The low of students’ achievement in mathematics subjects was found in various levels of education in Indonesia in the 2015/2016 and 2016/2017 academic year, one of junior high school education in Central Java, especially SMP in Karanganyar Regency which is 17th 36. The learning achievement of students of mathematics should be sought for improvement in improving the quality of education because the average value of mathematics subjects was relatively lower compared to other subjects as in Table 1 below.

Table 1. The average students’ achievement of national examination (UN) at SMP Negeri in Karanganyar Regency academic years 2015/2016 and 2016/2017 [2].

| Academic years | Subjects          | Examination score |
|---------------|------------------|-------------------|
|               |                  | Average | Lowest | Highest |
| 2015/2016     | Indonesia Language | 71.57   | 4.0  | 100     |
|               | English Language  | 57.02   | 10.0 | 100     |
|               | Mathematic       | 50.12   | 2.5  | 100     |
|               | Science          | 56.71   | 5.0  | 100     |
|               | Indonesia Language | 72.59   | 16.0 | 100     |
| 2016/2017     | English Language  | 47.36   | 12.0 | 100     |
|               | Mathematic       | 52.60   | 5.0  | 100     |
|               | Science          | 56.58   | 12.5 | 100     |

Based on Table 1, it can be seen that the average of national exam scores in 2015/2016 and 2016/2017 academic year of mathematics subject matter was still low, wherein mathematics subjects had an average under other subject matter. The low score obtained in mathematics showed that the weaknesses and difficulties of students in learning mathematics. This also indicated that students had poor control of mathematics subject matter. These problems can be seen through the percentage of mastery of the mathematics questions in the national exam in the State Junior High School in Karanganyar Regency in 2015/2016, which was lower than the 2016/2017 school year. The percentage of mastery in social arithmetic material for the 2015/2016 academic year in Karanganyar Regency was 46.86 lower than at the national level of 52.97. While the percentage of mastery in social arithmetic material in the 2016/2017 school year in Karanganyar Regency is 47.25 lower than at the national level which is equal to 48.60. The low percentage was caused by the lack of mastery of concepts in social arithmetic material.

Beside that problem above, in some material on mathematics lessons especially social arithmetic material, the absorption of students' national exam results in some of the abilities tested in the material was still relatively low. This can be seen from the absorption of mathematical questions in the social arithmetic material of the national exam in Central Java District of Karanganyar District in the academic year 2015/2016 and 2016/2017 as in Table 2.
Table 2. the ability of result national examination at SMP Negeri in Karanganyar Regency, central java province in academic years 2015/2016 and 2016/2017 [2].

| Academic year | Ability tested                                                                 | Karanganyar Regency | Province | National |
|---------------|--------------------------------------------------------------------------------|---------------------|----------|----------|
| 2015/2016     | Three tables are given by the goods, price, and discount. students can determine the amount of the price of goods (which must be paid) from the a first type, b the second type, and c the third type (a, b, c the original count is less than 5) | 53,85               | 53,93    | 57.39    |
|               | Students calculate the purchase price of an item, if the selling price is known and the percentage of profit or loss | 45,60               | 45.99    | 49.08    |

Based on the table 2 showed that the ability of result national examination with the arithmetic material was categorized low. then based on the percentage of mastery of national exam material in mathematics in the junior high school year 2015/2016, the absorption of the subject matter of social arithmetic in Karanganyar District (53.85%) is relatively lower than the provincial level (53.93%) and national level (57.39%). Likewise, in 2016/2017 the absorption of the subject matter of social arithmetic in Karanganyar Regency (45.60%) was relatively lower compared to the provincial level (45.99%) and national level (49.08%).

The reality in the field of teaching and learning process carried out by teachers was still oriented to mastery of subject matter and did not pay attention to the substance, meaning or value contained in the subject matter especially in junior high school mathematics subject matter social arithmetic concepts. Based on observations of middle school students and mathematics teachers, it turned out that some students still had difficulty in understanding social arithmetic material.

Seeing the low results obtained by students on the subject matter, further research was needed on the subject matter. Thus, it can be stated that the majority of junior high school students in Karanganyar Regency had difficulty in solving questions related to social arithmetic. The description of the data above was a learning achievement based on the students in cognitive aspects. An achievement test was used to put forward their learning performances [3].

There were other factors that influence the success of a learning process, namely factors that come from students. Every individual adopts a unique way to obtain knowledge and this way of acquiring knowledge is known as learning style [4]. According to Hasrul stated that "the learning style of students was a combination of how someone absorbs and then organizes and processes information [5]. There were three types of learning styles, namely auditory (learning through what they hear), visual (tend to learn through what they see), and kinesthetic (learning through motion and touch). One of the most important uses of learning styles is that it makes it easy for teachers to incorporate them into their teaching [6]. Developing knowledge of different learning styles among the student population are important in designing curricula, and adopting teaching methods that to promote student learning is a crucial part of ensuring that students engage positively with content and develop the deep learning skills needed for lifelong learning [7]. Good learning achievement can reflect a good learning style because
by knowing and understanding the learning style that is best for him will help students in learning so that the resulting achievement will be maximum [8]. In order to help students learn, teachers need to teach as many of these preferences as possible [9].

2. Method
This study used descriptive quantitative methods. The method in this study was used to analyze the achievements of students who had auditory learning styles, visual learning styles, and kinesthetic learning styles. Before choosing a subject, the researcher provided a learning style questionnaire to get students with auditory learning styles, visual learning styles, and kinesthetic learning styles. Then, the researcher gave an 80-minute multiple-choice mathematical written test. This research was conducted in junior high school 4 Karanganyar with heterogeneous abilities. The subjects of this study were 32 students from class VII who were selected using simple random sampling taken randomly regardless of the strata in the population, then class VIII-F was selected.

The data analysis used in this study was descriptive data analysis and quantitative data analysis. Descriptive data were obtained from learning style questionnaires, while quantitative data were obtained from the results of learning achievement tests. Descriptive data analysis was only limited to knowing students who have auditory learning styles, visual learning styles, and kinesthetic learning styles. Quantitative data analysis was used parametric statistics in this study taken from the test results of students using the t-test. But before the t-test, the researchers conducted a normality test. T-test using Paired Sample t-Test and normality test using liliefors which are assisted by SPSS 20 for Windows 7.

3. Results and discussion
The results of the analysis of achievement test questions obtained by the results of UTS which conducted 26 students above the KKM and 6 students got the same score KKM with a KKM value of 75. The average score of students was 82.19. From the post-test results, there were 32 students above the KKM with the average score of students being 84.90. Complete data analysis of student learning outcomes tests can be seen in the appendix. Therefore, it can be concluded that there was an increase in UTS and post-test results.

The results of the learning style questionnaire analysis showed that of the 32 students who filled out the learning style questionnaire, 13 students had auditory learning styles, 7 students had kinesthetic learning styles, and 12 students had visual learning styles. Viewed from the value of the average learning achievement of each learning style, it was found that 81.43 for students who had kinesthetic learning styles, 85.30 for students who had visual learning styles, and 86.40 for students who had auditory learning styles. After processing data with Statistical Product and Service Solutions [10], the data obtained as follows:

|       | Kolmogorov-Smirnov* | Shapiro-Wilk |
|-------|---------------------|--------------|
| Statistic | df | Sig. | Statistic | df | Sig. |
| nilaiUTS | .126 | 32 | .200* | .938 | 32 | .066 |
| posttest | .125 | 32 | .200* | .938 | 32 | .064 |

* This is a lower bound of the true significance.

a. Liliefors Significance Correction

Based on the table above, it can be seen that the Sig on the Kolmogorov-Smirnova ‘s column to evaluate the pre-test (0.200) and to evaluate the post-test (0.200). In accordance with the test criteria, that if the value of Sig. > 0.05 then H0 is accepted and H1 was rejected. So, the pre-test and post-test data were as normally distributed. In accordance with the test criteria, that if the value of Sig. > 0.05 then H0 was accepted and H1 was rejected. So, the pre-test and post-test data were normally distributed.
The results of test analysis were used t-test with the help of Statistical Product and Service Solutions [10] on social arithmetic material obtained the following results:

Table 4. Paired samples statistics.

|       | Mean   | N   | Std. Deviation | Std. Error Mean |
|-------|--------|-----|----------------|-----------------|
| Pair 1 | nilaiUTS 82.1875 | 32  | 5.40273       | .95508          |
|       | posttest 84.9000    | 32  | 5.67121       | 1.00254         |

Table 5. Paired samples correlations.

|       | N   | Correlation | Sig. |
|-------|-----|-------------|------|
| Pair 1 | 32  | .933        | .000 |

Table 6. Result of paired sample t-test.

| Paired Sample Test | Paired Differences | Std. Error Mean | 95% Confidence Interval of the Difference | t    | df | Sig. (2-tailed) |
|-------------------|--------------------|-----------------|------------------------------------------|------|----|----------------|
|                   | Mean               | Std. Dev        | Lower                                    | Upper|    |                |
| Pair 1            | Soal_pretest-soal_posttest | -2.713       | 2.043                                     | .361 | -3.44 | -1.976         | -7.507 | 31 | .000            |

Based on table 4 can be seen that degree of Sig. (2 tailed) score 0.000 meant less than 5% (0.05), it can be concluded that there was increased of student’s achievement in middle semester test and the result of post-test in arithmetic social class VII at SMP 4 Karanganyar, Indonesia.

4. Conclusion
Based on the results of research on learning achievement based on the characteristics of learning styles, the conclusions can be drawn, namely the calculations show t-count for learning outcomes of -7.507. Sig. (2-tailed) (0,000) <α (0.05). This indicates that H0 was rejected, H1 was accepted. So that it can be concluded that there was an increase in student learning outcomes, namely in the results of the UTS with the results of post-test class VII social arithmetic material at Junior high school 4 Karanganyar Regency. The results of the learning style questionnaire analysis showed that of the 32 students who filled out the learning style questionnaire, 13 students had auditory learning styles, 7 students had kinesthetics learning styles, and 12 students had visual learning styles. Viewed from the value of the average learning achievement of each learning style, it was found that 81.43 for students who had kinesthetics learning styles, 85.30 for students who had visual learning styles, and 86.40 for students who had auditory learning styles.

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