Improving the basic skills of teaching mathematics through learning with search-solve-create-share strategy

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Abstract. This study examined to see the improvement of prospective teachers’ basic skills of teaching mathematics through search-solve-create-share learning strategy based on overall and Mathematical Prior Knowledge (MPK) and interaction of both. Quasi experiments with the design of this experimental-non-equivalent control group design involved 67 students at the mathematics program of STKIP Garut. The instrument used in this study included pre-test and post-test. The result of this study showed that: (1) The improvement and achievement of the basic skills of teaching mathematics of the prospective teachers who get the learning of search-solve-create-share strategy is better than the improvement and achievement of the prospective teachers who get the conventional learning as a whole and based on MPK; (2) There is no interaction between the learning used and MPK on improving and achieving basic skills of teaching mathematics.

1. Introduction
The paradigm of teaching and learning activities which is widely used in this era is the activity of student-centered teaching and learning activity. In this paradigm, students are required to play an active role in establishing and developing their knowledge and abilities through various learning activities in the classroom. On the other hand, the teacher acts as a facilitator, who must always be ready to facilitate the various needs of the students in relation to the learning tasks to be done by the students on the learning activities particularly in the classroom. Therefore, teachers should be able to play this role appropriately in order to achieve the main purpose of learning.

In connection to this, there are many learning approach/model/strategies offered by experts to be used by teachers in optimizing the role. In addition, there are many researchers who conducted the research on the use of learning approach/model/strategy used in developing and improving the learning outcome of the student. Nevertheless, it is also found that the mathematics learning outcomes of students are still not optimal, as it is known based on the results of TIMSS and PISA survey recently.

According to this case, the author considered the need for a research towards the synchronization between the paradigm of learning and teaching activities outlined, the optimization on the role of teacher, learning approach/model/strategy offered, recommendations from the research results of the experts and the expected student's learning outcomes. The study of synchronization efforts disembogued to the basic skills of teaching mathematics on the prospective teachers. Because prospective teachers own a wide space to keep growing and a long period of time to keep practicing.
As stated in Law Number 12 of 2012 on Higher Education that learning in universities is expected to provide opportunities for students to develop cognitive, affective and psychomotor aspects optimally.

Related to that matter, The Indonesian Mathematical Society (IndoMS) has formulated learning outcomes of bachelor’s degree of mathematics education program based on several parameters, by which one of them is the parameter of field work capability. Learning outcomes based on the mentioned parameter is as follows: 1) To be able to plan, implement, and evaluate mathematics learning innovatively by applying didactical and pedagogical concepts of mathematics as well as to make use of various learning resources, science and technology which orientates in life skills; 2) To be able to study and apply various available mathematics learning methods innovatively; 3) To be able to assist students in mathematics learning; 4) To be able to plan and conduct research in order to obtain ways of solving problem in mathematics fields as well as to publish the findings [1].

Based on qualifications of learning outcomes in KKNI and the formulation by IndoMS, bachelor’s degree students majoring in mathematics education program should have good teaching skills as the foundation in teaching mathematics. Teaching skills are defined as a measurable and coherent activity that teachers use in order to make students learn [2]. Therefore, teaching skills are related to several skills or abilities which are fundamental and must be mastered by teachers in doing their job.

The importance of teaching skills is in accordance with Law Number 14 Year 2005 concerning teachers and lecturers, one of which is pertained to pedagogical competence and professional competence. Sanjaya (2009) states that for teachers, teaching skills are required in order to be able to perform their role in managing the learning process, so that the learning can run effectively and efficiently [3]. Ruseffendi (1991) states that one of the skills that mathematics teachers in high school need is the skill of being able to demonstrate various methods and techniques in teaching the subject that is being taught [4].

Based on that matter, every teacher should have good teaching skills. These skills involve skills in questioning, affirming, making variations, giving explanations, beginning and ending class sessions, guiding small group discussions, managing class, and individual teaching [5]. Teaching skills in teaching mathematics are related to several special abilities which are according to characteristics of mathematics, and it should be actualized by every teacher [6-11].

In reality, it is demonstrated that teaching skills of most pre-service teacher are still low, which is evidenced in several previous studies [12-14]. Based on these results, it can be concluded that the basic skills of teaching students are not optimal and it needs to be improved. It is caused by the lack of opportunities to probe and integrate various things in relation to mathematics learning.

This problem should be soon addressed through the use of specific strategy in designing learning activities in class, so that learning process can be beneficial for the students. One of the learning strategies that is believed can improve teaching skills on pre-service teacher is learning with Search-Solve-Create-Share (SSCS) strategy. Learning stages of SSCS strategy consist of four phases: search, solve, create, and share phase.

2. Methods
The research design used for quantitative methods in this research was quasi-experimental design which was in the form of Non-equivalent Control Group Design. In this quasi experiment, subjects are not randomly grouped but the researcher directly accepted the circumstances of the subject [15]. The research design is described as follows:

| Experiment Group | O | X | O |
|------------------|---|---|---|
| Control Group    | O | X | O |

Notes:
O = The pretest and posttest on the basic skills of teaching mathematics
X = Learning with search-solve-create-share strategy
This research used two groups of research subjects, which were experimental groups who received learning with search-solve-create-share strategy (SSCS) and control groups who received conventional learning. Both groups were given a pretest and posttest with the same instrument. Pretest was aimed to view the initial conditions of basic skills of teaching mathematics on both groups before the treatments. Posttest was conducted after the treatment is completed with the aim to determine the effect of learning given towards the achievement and improvement of basic skills of teaching mathematics to the prospective teacher.

To determine a deeper effect of learning with the use of SSCS strategy towards basic skills of teaching students, this research involved the mathematical prior knowledge factor of the student (high, moderate and low).

3. Results and Discussion

The basic skill test of teaching mathematics was given at the beginning (pretest) and at the end (posttest) of learning activities. The achievement of the basic skill test of teaching mathematics on students can be observed from their posttest average scores. To observe the improvement on the basic skill of teaching mathematics on students, normalized gain (N-gain) has been used.

The recapitulation on the analysis result of post-test scores on the basic skills of teaching mathematics on students based on the overall learning activities is presented in Table 1 below.

| Posttest | Learning       | Score |  \( \bar{x} \) |  \( ds \) |
|----------|----------------|-------|---------------|-----------|
| BSTM     | SSCS           | 62    | 26            | 44,15     | 9,26      |
| (IMS = 76) | Conventional   | 51    | 28            | 37,33     | 5,22      |

(Notes: IMS = Ideal Maximum Score)

Based on the above table, it appears that the achievement of basic skills of teaching mathematics on students who obtained the learning activities with SSCS strategy is higher than students who obtained conventional learning. The achievement qualifications in both learning groups are on the same criteria, which was the moderate criteria.

Furthermore, the analysis result on the basic skills of teaching mathematics post-test score based on learning from MPK group can be seen in Table 2 below.

| Posttest | Level of MPK | Learning | Score |  \( \bar{x} \) |  \( ds \) |
|----------|--------------|----------|-------|---------------|-----------|
| BSTM     | High         | SSCS     | 57    | 37            | 48,71     | 6,99      |
|          |              | Conventional | 48    | 40            | 42,57     | 2,82      |
|          | Moderate     | SSCS     | 62    | 31            | 45,62     | 8,63      |
|          |              | Conventional | 51    | 30            | 37,39     | 4,83      |
|          | Low          | SSCS     | 42    | 26            | 33,67     | 6,22      |
|          |              | Conventional | 36    | 28            | 32,63     | 2,92      |

Based on Table 4, it appears that the achievement on the basic skills of teaching mathematics on students for each MPK group who obtained the learning activities with SSCS strategy is higher than students who obtained conventional learning. In addition, it is also apparent that the achievement of basic skills of teaching mathematics on students who received learning activities with SSCS strategy in high MPK groups was higher than in moderate MPK groups and low MPK groups. However, the achievement on the basic skills of teaching mathematics on students who were learning with SSCS
strategy in moderate MPK group was higher than the achievement of basic skills of teaching mathematics on students who obtained conventional learning in high MPK group.

Thus, learning with SSCS strategy can further develop the student's basic skills of teaching mathematics in each MPK group compared with conventional learning. Student's basic skills of teaching mathematics in MPK group who received SSCS strategy improved more than the high and low MPK groups. Furthermore, basic skills of teaching mathematics on students was high in MPK group who received SSCS strategy developed more than the low MPK group.

The recapitulation on the analysis result of pre-test and post-test of basic skills of teaching mathematics and the normalized gain (N-gain) based on the overall learning activities is presented in Table 3 below.

Table 3. The Recapitulation of Pretest-posttest and the Normalized Gain (N-gain) Based on the Overall

| Test  | Learning      | Score Max | Score Min | \( \bar{x} \) | \( ds \) | N-gain | Criteria |
|-------|---------------|-----------|-----------|---------------|--------|--------|----------|
| PRBSTM| SSCS          | 43        | 15        | 23.91         | 6.22   | 0.39   | Moderate |
| POBSTM| Conventional  | 62        | 26        | 44.15         | 9.26   |        |          |
| PRBSTM| Conventional  | 34        | 15        | 23.38         | 4.85   | 0.25   | Low      |
| POBSTM| Conventional  | 51        | 28        | 37.33         | 5.22   |        |          |

Note: PR = Pretest, PO = Posttest.

Based on Table 3 above, it was apparent that the improvement of basic skills tests of teaching mathematics on students who obtained the learning activities with SSCS strategy was higher than students who obtained conventional learning. Improvement qualifications of basic skills tests of teaching mathematics on students with the SSCS strategy was categorized as moderate, whereas basic skills tests of teaching mathematics on students with the conventional strategy was categorized as low.

Furthermore, the recapitulation on the N-gain analysis result of basic skills of teaching mathematics based on learning activities reviewed from MPK group can be observed in Table 4 below.

Table 4. The Recapitulation of Normalized Gain (N-gain) Based on the MPK

| Group of MPK | Learning      | N-gain Score Max | N-gain Score Min | \( \bar{x} \) | \( sd \) | N-gain Criteria |
|--------------|---------------|------------------|------------------|---------------|--------|----------------|
| High         | SSCS          | 0.54             | 0.20             | 0.40          | 0.12   | Moderate       |
| Moderate     | Conventional  | 0.53             | 0.23             | 0.33          | 0.06   | Moderate       |
| Moderate     | SSCS          | 0.75             | 0.26             | 0.44          | 0.13   | Moderate       |
| Moderate     | Conventional  | 0.53             | 0.15             | 0.27          | 0.09   | Low            |
| Low          | SSCS          | 0.40             | 0.13             | 0.23          | 0.10   | Low            |
| Low          | Conventional  | 0.20             | 0.05             | 0.14          | 0.05   | Low            |

Based on Table 4, it appears that the improvement of basic skills of teaching mathematics on students for each MPK group who obtained the learning activities with SSCS strategy is higher than students who obtained conventional learning. The improvement of basic skills of teaching mathematics on student for the MPK group was high in the two learning groups on the medium criteria. In moderate MPK groups, the increase in basic skills of teaching mathematics of students who received the learning activities with SSCS strategies are categorized in moderate criteria, and the increase in basic skills of teaching mathematics of students who received conventional learning are categorized in low criteria. The improvement of student's basic skills of teaching mathematics for the low MPK group in the two study groups was categorized as low criteria.

In addition, it also appears that the increase in basic skills of teaching mathematics of students who received the learning activities with the SSCS strategy in the moderate MPK group is higher than that
of the high MPK group and the low MPK group. The improvement of basic skills of teaching mathematics of students who obtained the learning activities with SSCS strategy in MPK group is higher than the increase of basic skills of teaching mathematics of students who obtained conventional learning in high MPK group.

Thus, learning with SSCS strategy may further develop the student's basic skills of teaching mathematics in each MPK group compared with conventional learning. Basic skills of teaching mathematics of students in moderate MPK group who received SSCS strategy improved more than the high and low MPK groups.

The overall recapitulation of test result on the difference of average achievement and improvement of student's basic skills of teaching mathematics based on learning activities can be seen in the following Table 5.

**Table 5.** The recapitulation of Test Result on the Average Differences of Achievement and Improvement of basic skills of teaching mathematics based on the Overall Learning Activities

| BSTM Test   | learning          | t    | df     | p-value (sig.) | Note       |
|-------------|-------------------|------|--------|----------------|------------|
| Achievement | SSCS              | 3,724| 52,390 | 0.000          | H₀ is rejected |
|             | Conventional      |      |        |                |            |
| Improvement | SSCS              | 4,518| 57,586 | 0.010          | H₀ is rejected |
|             | Conventional      |      |        |                |            |

Based on the calculation in Table 5 above, it can be seen that the average achievement and improvement of basic skills of teaching mathematics has a p-value value (sig.) less than 0.05. Since the p-value (sig.) is less than 0.05, then H₀ is rejected. Therefore, it can be concluded that the achievement and improvement of basic skills of teaching mathematics on students who obtained the learning activities with SSCS strategy is better than students who received conventional learning, overall review.

Recapitulation of test result on the average differences of basic skills of teaching mathematics achievement of student based on learning from high, moderate and low MPK group and improvement of basic skills of teaching mathematics on student based on learning from high and low MPK group can be seen in the following Table 6.

**Table 6.** Recapitulation of Test Result Differences Mean Achievement and Improvement of BSTM in terms of MPK Group

| BSTM Test | Group of MPK | Learning | Mean     | t     | p-value (sig.) | Notes     |
|-----------|--------------|----------|----------|-------|----------------|-----------|
|           | High         | SSCS     | 48.71    | 2.155 | 0.052          | H₀ is accepted |
|           |              | Conventional | 42.57  |       |                |            |
|           | Moderate      | SSCS     | 45.62    | 3.379 | 0.001          | H₀ is rejected |
|           |              | Conventional | 37.39  |       |                |            |
|           | Low          | SSCS     | 33.67    | 0.420 | 0.682          | H₀ is accepted |
|           |              | Conventional | 32.63  |       |                |            |
|           | High         | SSCS     | 0.395    | 1.263 | 0.241          | H₀ is accepted |
|           |              | Conventional | 0.330  |       |                |            |
|           | Low          | SSCS     | 0.215    | 1.770 | 0.148          | H₀ is accepted |
|           |              | Conventional | 0.145  |       |                |            |
Based on the data in Table 6 above, it appears that the p-value (sig.) for basic skills of teaching mathematics achievement data for the high and low MPK group is greater than 0.05, then H₀ is accepted. Therefore, it can be concluded that there is no difference in basic skills of teaching mathematics achievement of students who obtained learning activities with SSCS strategy and students who obtained conventional learning in terms of high and low MPK group. For basic skills of teaching mathematics achievement of moderate MPK group, the p-value (sig.) is less than 0.05 then H₀ is rejected. Therefore, it can be concluded that for moderate MPK group, the achievement of basic skills of teaching mathematics on students who obtained learning activities with SSCS strategy is better than students who obtained conventional learning.

Based on the data in Table 6, the increase of basic skills of teaching mathematics in student, the high and low MPK group has a p-value (sig.) greater than 0.05 then H₀ is accepted. Therefore, it can be concluded that for high and low MPK groups, the increase in basic skills of teaching mathematics of students who received learning activities with SSCS strategy did not differ significantly from students who received conventional learning.

Recapitulation of test result on the average differences of basic skills of teaching mathematics improvement of student based on learning process viewed from moderate MPK group can be seen in Table 7 below.

**Table 7. Recapitulation of Average Differences Test Result of Basic Skills of Teaching Mathematics Improvement reviewed from Moderate MPK Group**

| Learning | **Mann-Whitney Test** | Z    | **p-value (sig. 2-tailed)** | Note          |
|----------|-----------------------|------|----------------------------|---------------|
| SSCS     | 51.000                | -3.890 | 0.000                     | H₀ is rejected |
| Conventional |                   |       |                           |               |

Based on the calculation in Table 7 above, it is known that the z-value was -3.890 with p-value (sig.) of 0.000. Since the p-value (sig.) is less than 0.05, then H₀ is rejected. Therefore, it can be concluded that for the moderate MPK group, the increase in basic skills of teaching mathematics on students who obtained learning activities with SSCS strategy is better than students who obtained conventional learning.

The recapitulation of the calculation results with two-tailed ANOVA test can be seen in Table 8 below.

**Table 8. The Recapitulation of ANOVA Calculation Result of Basic Skills of Teaching Mathematics Achievement Based on Learning Activities and MPK Groups**

| KDMM Test | Resource   | The Sum of Square | ² | Mean Square | F     | p-value (sig.) |
|-----------|------------|-------------------|---|-------------|-------|----------------|
| Achievement | Learning | 349.145           | 1 | 349.145     | 8.582 | 0.005          |
|           | Group of MPK | 1149.559       | 2 | 574.780     | 14.129| 0.000          |
|           | Learning* | 130.994           | 2 | 65.497      | 1.610 | 0.208          |

The interaction between learning and MPK groups towards basic skills of teaching mathematics can be seen in Table 8. In the table, it appears that the interaction of learning factors and MPK factors has an F-value of 1.610 and a significance greater than 0.05 which is 0.208. Therefore, it can be concluded that there is no interaction between learning factors and MPK factors towards student’s basic skills of teaching mathematics achievement.

Average line graph of basic skills of teaching mathematics improvement of students who obtained learning with SSCS strategy and average line graph of basic skills of teaching mathematics improvement of students who obtained conventional learning does not intersect. This indicated that
there was no interaction between learning factors and MPK towards the improvement of student's basic skills of teaching mathematics. Thus, the effectiveness and the learning strategy used was not dependent on MPK towards improving the student's basic skills of teaching mathematics.

4. Conclusion
Learning with SSCS strategy in this research was a learning activity that emphasizes the active role of students in establishing their own knowledge and competence through search, solve, create and share stages. The stages in this learning is a unity that support each other and implemented in an integrated manner.

Based on the result of the research, it was found that in general, the achievement and improvement of basic skills of teaching mathematics on students who obtained the learning activities with SSCS strategy is better than students who obtained conventional learning, whether it was reviewed as a whole or reviewed based on KAM group. The better achievements and improvements was considered possible because the learning activities with SSCS strategy provides an opportunity for students to explore and improve their competence through a series of learning activities that support them. In learning with the SSCS strategy, students (prospective teachers) are given the freedom to look for possible solutions (search stage) and then provide solutions related to the mathematics teaching (solve stage) and there were several feedbacks from other students about the effectiveness of teaching designs created (create stage) and practiced them (share stage). This condition is in line with the opinion of Pizzini (in Ramson, 2010: 8) which stated that teachers play a role in facilitating the experience to increase the students' knowledge.

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