Improving student’s complex problem solving through LAPS-Talk-Ball learning integrated with interactive games

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Abstract. One of the competencies needed currently is non-routine competency in solving a complex problem. Students with complex problem solving will be able to identify the complex problem, understand to review related information, and create solutions for the problems. However, the improvement of complex problem-solving abilities lacks attention. This phenomenon occurs when students are given problem-solving, students have not been able to understand the problem, plan solutions, and provide solutions to problems. To overcome these problems, the LAPS-Talk-Ball learning model integrated with interactive games that guide the students in solving problems was implemented by using interactive games and speech balloons to stimulate each student to express their ideas. This research is quantitative experimental research to determine the success of the LAPS-Talk-Ball learning model integrated with android-based interactive games in training complex problem-solving students using saturated sampling and non-equivalent control group research designs. From the results of gain test results high improvement category, which means that the LAPS-Talk-Ball learning model integrated with android-based interactive games can train the complex problem-solving abilities of students.

1. Introduction
In the last decade, Complex Problem Solving (CPS) ability has become an important ability as an indicator of academic achievement in educational research [1]. CPS is the ability to identify complex problems, as well as understand and review related information, in order to create solutions to problems. This ability is one of the essential abilities needed in a dynamic work environment [2]. CPS involves the ability to solve problems that are difficult to define and significant [3], and CPS is emphasized as a key competency of learning and future success because it combines aspects of cognitive, emotional, and motivation [4-5]. Students with higher CPS abilities can use previous knowledge more proficiently when learning new content; thus, their learning is faster and deeper. CPS has been considered an indicator of academic achievement and the main indicator of achievement in other skills. Given the importance of CPS, it is very surprising that, to this day, the CPS ability of students is still low.

The student's problem-solving ability is in a low category. It can be seen that when students are given problem-solving questions, students still cannot understand the problem and cannot express the information on the problem properly. Students lack in developing strategies to plan solutions and do not check the solutions given [6]. One of the low student problem-solving abilities is the lack of
opportunities for students to improve and develop problem-solving abilities. Given the increasing importance and need of CPS at present and in the future, students' abilities are not accompanied by an increase in complex problem-solving abilities so that continuous research is needed to improve students' CPS abilities.

The era continuously demands increasingly complex student skills, which must be followed by teachers' skills using current learning models through mastery of technology as a condition to keep up with the times [7]. Teachers in the 21st century are required not only to be able to teach and manage classroom activities effectively but also to be creative in making learning more interesting, developing variations in learning by elaborating learning using technology to support improving the quality of teaching, and reflecting and evaluating their teaching practices continuously [8]. Increasing students' CPS abilities can be obtained by applying a learning model that guides in solving problems [9]. The CPS of students can be skilled through computer-based training and evaluation, which requires completion steps quickly and precisely [10].

One alternative solution is to apply the LAPS-Talk-Ball learning model integrated with an Android-based interactive game to overcome the above problems. The LAPS-Talk-Ball learning model is a modified version of the LAPS-Heuristic and Talking Stick learning model. LAPS-Heuristic is one of the learning model of problem solving that can be used to solve problems that are not routine, is not yet known how the solution with search or find solutions to problems so that it can arouse curiosity, motivation, active students as well as increase reasoning ability as part of the indicators of problem solving [11-14]. However, the learning model Laps-Heuristic has the disadvantage that in the process of learning where the liveliness of the students is dominated by students with the cognitive ability high while the students are passive will be more passive. Therefore, the learning model of the Talking Stick is integrated into the model Laps-Heuristic by replacing the stick with colorful balloons with the use of several media-based learning android applications to make the learning more interesting, enjoyable and meaningful. The advantages of the talking stick model will cover the weaknesses LAPS-Heuristic that is where the model is able to test the readiness of the student in the learning, practice communication skills, as well as invite students in any situation [15-17]. The use of the LAPS-Talk-Ball learning model integrated with Android-based interactive games provides problem-solving learning through guidance in solving problems. The evaluation uses Quizizz as an interactive game based on Android, which contains a series of questions to increase students' activeness, proficiency, and accuracy in solving problems. Quizizz provides statistical data on student performance so that teachers can track how many students answered questions, and the data can be directly downloaded in the form of an Excel spreadsheet. The "homework" feature is also an interesting addition to the application, which can be set over time. With Quizizz, students can study and play anytime and anywhere. This research aims to determine the extent to which learning model LAPS-Talk-Ball integrated interactive games in improving the ability of Complex Problem Solving (CPS) of the students. Therefore, this research can be useful for schools' learning activities to make it more interesting, interactive, effective, and efficient, especially in mathematics.

2. Method
Quantitative research using a quasi-experimental design type non-equivalent control group design was used in this study. The experimental design is described in Figure 1. Students were given pretest questions to determine each class's initial ability before the treatment begins, both the experimental class and the control class. Especially for the experimental class, the class was given the LAPS-Talk-Ball learning model integrated with an Android-based interactive game. Whereas in the control class, using a learning model that is usually used by teachers in mathematics for statistics material. Some of the applications used in this research is the group maker which is useful to divide the rest of the group the students based on how to pick one to divide the students in a fair and heterogeneous, the application of Padlet used as a blackboard online that allow collaboration between students in solving problems that are dealt. The application of Quizizz useful as interactive games that are used as the evaluation process of students. In support of the students to be able to remove the idea-the idea is then to use the balloon, it turns the balloon will be rolled out to all students. Students who get the balloons is obliged to disclose the idea or ideas in the form of questions, answers, feedback, criticism, or solutions. Useful to select the
students do a presentation, ask, answer, refute and conclude, so that learning is dominated by students (student centered).

Figure 1. Non-equivalent control group design (the sampling used was purposive sampling with one comparison class, namely the control class)

This research was conducted for approximately three months with the research location at SMAN 11 Bone, Patimpeng District, Bone Regency. The population in this study included students of class XI MIPA 1 and XI MIPA 4 as many as 56 students. The sample in this study was divided into two classes, with 28 students as the class XI MIPA 4 as the experimental class and 28 students as the XI MIPA 1 class as the control class. A total sampling technique was used in this research. Data were collected using test descriptions as a result of learning and observation. Subjective tests (narrative form) were given to students.

3. Results and Discussions
This research was conducted at SMAN 11 Bone in order to improve students' complex problem-solving abilities in mathematics for statistics by applying the LAPS-Talk-Ball learning model integrated with Android-based interactive games in class XI MIPA 4 students as an experimental class. In comparison, the application of the learning model commonly used by teachers in class XI MIPA 1 students was classified as the control class.

- Phase 1: Preparation with the help of Group Maker and Quizizz. The teacher carried out the preparations by dividing groups of students using the group maker application, delivering learning materials, and carrying out comprehension quizzes using Quizizz.
- Phase 2: Implement the LAPS Process with the help of Padlet. The teacher gave integrated group worksheets with Padlet for each group to solve the problem with the question, such as what is the problem? How to do it? What is the solution? Which solution is the most appropriate to overcome these problems?
- Phase 3: Carry out the Talk-Ball process with the help of speech balloons and Quizizz for student evaluation. At this stage, the teacher trained students to group discussions to check solutions on the student group worksheets. The teacher applied balloons to select student presentations, ask questions, answer, argue, and conclude. At the end of the lesson, an individual quiz was carried out using Quizizz to evaluate student understanding.

Based on statistical analysis, the average value of complex problem-solving abilities in the control class on the pretest was 52.52, while the experimental class had an average score of 51.85. The average value of complex problem-solving abilities in the final test (post-test) in the experimental class was 85.25, with a gain of 0.71 (high category) higher than the control class with an average value of 77.15 gain of 0.56 (medium category) (see Figure 2).
**Figure 2.** The comparison on complex problem-solving ability of test results (the comparison before treatment for the control class (a) and the experimental class (b); after treatment for the control class (c) and the experimental class (d); and the average increase in the control class (e) and experimental class (f))

To test whether there are differences in the average value of the CPS capabilities between the control class and experimental class, the data were tested for normality and homogeneity in advance. The normality test was carried out with the One-Sample Kolmogorov-Smirnov Test, which was analyzed using SPSS by comparing the probability ($p$) with the alpha ($\alpha$) value. If the probability ($p$) is greater than alpha ($\alpha$), the test results are normally distributed. The normality test as seen in Table 1.

| Component                        | $p$        | Criteria            |
|----------------------------------|------------|---------------------|
| Pretest of experiment class      | 0.074      | Normally distributed|
| Post-test of experiment class    | 0.012      | Not normally distributed|
| Pretest of the control class     | 0.148      | Normally distributed|
| Post-test of the control class   | 0.001      | Not normally distributed|

After the pretest score is normally distributed, and the post-test is not normally distributed, the homogeneity test should be conducted to test the data variance. The homogeneity test was carried out by comparing the probability ($p$) with the alpha ($\alpha$) value. If the probability ($p$) is greater than alpha ($\alpha$), the test results are homogenous. The homogeneity test as seen in Table 2.

| Class                          | $p$        | Criteria     |
|--------------------------------|------------|--------------|
| Pretest Control and experiment class | 0.648     | Homogenous   |

Based on the above output, the $p$-value was greater than 0.05 ($p > 0.05$). Thus, the variances of the experiment and control class were homogenous and can be compared. The prerequisite test shows that the data is not normally distributed and homogeneous, then the hypothesis testing is carried out using non-parametric statistics of the Mann-Whitney test as seen in Table 3.

| $Z_{calculated}$ | $p$       | Annotation    |
|------------------|-----------|---------------|
| -3.252           | $\rho < 0.001$ | $H_0$ rejected |
If the p-value is greater than 0.05 ($p > 0.05$), $H_0$ is accepted, vice versa. Table 3 show that the hypothesis test results, it was obtained that $p > \alpha$ or 0.001 > 0.05, then $H_0$ was rejected. It means that the application of the LAPS-Talk-Ball learning model integrated with android-based interactive games was able to train students' CPS abilities.

LAPS-Talk-Ball learning provides concrete and real problems; therefore, it impacts students' reasoning abilities in solving complex problems. The accordance study by Asfar et al. [18] stated that learning by implementing the concept of reasoning in students and linking their previous knowledge with real-life contexts will impact students' problem-solving abilities. The granting of the problems often found in everyday life will be useful in improving the ability of Complex Problem Solving because students will be more able to understand the cause of the problem and are easy to make the solution of the problem [19]. In addition, the application of Laps-Talk-Ball in the class of experiments shows students are interested in solving is given because it is associated with the activities of their daily lives (real context), so they are easier to perform reasoning to identify the problem, understand the problem then make the settlement of the problem. The ability of CPS can be trained by giving the student problems that aim to use patterns of solving the problem in a comprehensive and systematic of the phenomenon-a real phenomenon based on the hypothesis and the facts [20], [21]. Since the difference occurred in comparison to increasing CPS ability on the student, the analysis regarding pretest and post-test results was carried out accordingly. Based on the gain test, experiment and control class scores were 0.71 and 0.56, respectively. The experiment class is categorized as a high category, while the control class is categorized as a medium category. It means that the increasing CPS ability of the student using the LAPS-Talk-Ball learning model integrated interactive games based on Android is significantly high.

Providing problem-solving exercises in the LAPS learning model process is also a trigger in increasing students' complex problem-solving abilities. One of the impacts of implementing this model is that students are enthusiastic and active in doing quizzes on material understanding and individual evaluation through the interactive game Quizizz on Android and the creation of group cooperation through an Android-based integrated Padlet-based LKK (group worksheets) which makes student group work more enjoyable with adequate processing time. The cooperation between students as well as high motivation in learning plus teacher guidance in resolving complex problems will train the ability of complex problem solving of students [22]. In addition, the integration of android based applications as a medium of learning to facilitate students learning anywhere and anytime [23]. The use of android-based application gives impact to the students more confident and motivated to practice solving problems of different related teaching materials both at the time of learning in the school and outside the school environment. Confidence and motivation is one factor supporting the success of CPS as a result of the process of education and learning [24]. The use of android in the learning process has an impact on the ability to give feedback faster than conventional learning so far carried out by teachers. Feedback is related to checking errors through teacher evaluation of the mistakes made by students on the exercises or assignments given and can quickly be seen by students and teachers together and interactively. This evaluation system affects self-confidence and motivation in learning because students know as quickly as possible their mistakes in identifying problems, reviewing problem information, and problem-solving solutions. These three indicators are part of complex problem-solving abilities, so that if they are trained on an ongoing basis it will affect the ability to solve complex problems, both in learning and in everyday life.

4. Conclusion
The application of the LAPS-Talk-Ball learning model integrated with interactive games can improve students' complex problem-solving abilities. Interactive games are used based on Android, where each student is permitted to use a smartphone that is distributed during learning. The application of the LAPS-Talk-Ball learning model with interactive games such as Quizizz is integrated with other applications such as Padlet to strengthen learning that provides a fun and meaningful conditions. This strengthening is felt when students are enthusiastic about learning by collaborating in solving given problems. Besides, student motivation in learning increases with a touch of technology. The use of interactive games with the LAPS-Talk-Ball learning model needs to be applied, especially mathematics learning, to increase the ability to solve complex problems.
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