Collaborative classroom action research for mathematics and science teachers in Indonesia

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Abstract. Based on government regulation, as a part of career advancement for teachers in Indonesia, they need to do a Classroom Action Research (CAR) to reach the next level professional career. Unfortunately, this policy leads to problems that many teachers who find difficulties in doing classroom action research prefer using sort cut by asking agency to help them provide a well written classroom action research report. This situation triggered many people to take benefit by providing service for creating fake classroom action research for teacher as part of requirement in achieving next level in their career. There are some obstacles for teachers in doing classroom action research: (1) lack of knowledge theory in classroom action research; (2) lack of skill in designing instruments for data collection process; (3) lack of skill in analyzing the data; (4) lack of skill in writing the research report; (5) complicated regulation for teachers in conducting dissemination of their research. A model of TPD need to be formulated to overcome those obstacles and help mathematics and science teachers doing CAR for solving problems in their classroom or improving learning process and learning outcomes. A design research with engineering research approach is adopted as methodology of the study for designing a TPD model. The participants of the study are mathematics science teachers, lecturers, and supervisors from 5 provinces in Indonesia: North Sumatera, Riau, Jambi, Central Java, and East Borneo. This paper aims to describe the process and the result of the teachers’ professional development program for elementary and junior high school science and mathematics teachers in Indonesia through collaboration classroom action research with lecturer and school supervisors as the answer of those obstacles.

1. Introduction
Indonesia as the developing country with the largest population of school-age children in world faces many problems in education. Realized that teachers’ quality is main point for education reform in Indonesia, the government gives much focus in this issue related to Selection process, training, management and motivation, and incentives including financial reward [1]. In the year of 2005, the government of Indonesia through Ministry of Education and Culture (MoNEC) has proposed a law number 14 that focus on teaching profession. This regulation known as “Teachers and Lecturer Law”. This law stipulates the responsibilities of teacher and Lecturer as well as their salaries and working hours [2].

In addition, for supporting the Teachers and Lecturer Law, government also issued a regulation for the career advancement of teachers through Ministry of Administrative and Bureaucratic Reform
number 16 in the year of 2009 [3]. Based on this regulation, teachers no longer have to wait until 4 years to raise next level of position and level of professionalism automatically. Teachers can pursue the next level of position by collecting some credit points. This policy gives guarantee for teachers to improve their career by doing Continuous Professional Development (CPD) program [3]. There are three elements of CPD for teachers: doing self-development program, publishing scientific paper and doing innovative work. Self-development program is a program for teachers to develop their knowledge and skill through pursuing higher education, joining workshop or training and others activities that support their needs for teaching knowledge and skills. Teachers also can publish a scientific paper as the report or result of their research in the classroom. They can publish their paper in the form of a journal, or book and also present in a seminar or a conference. Teachers also can do an innovative work as a part of their experiences in solving problems in their classroom such as creating manipulative for teaching or invent a teaching technology or even designing an art work as a part of their teaching strategy. Actually, teachers are have various ways to do their CPD program but the highlight of this regulation is located at the point that teachers need to collect some credit points through doing a classroom action research and publishing a paper to be able to pursue not only Advanced teacher, level IV/a, IV/b, IV/c and Master teacher, level IV/d, level IV/e but also Intermediate teacher, level III/c and III/d so that doing a Classroom Action Research (CAR) is a key point for teachers in their CPD program [3].

Unfortunately, there are many teachers who still find CAR is difficult to be implemented in their part of CPD program [4], even though they know that CAR is important for their CPD and career development [5]. Most of teachers did CAR only for formality not for solving their problem in a classroom or for enhancing their students’ learning outcomes, almost more than 26% of her respondents said they did CAR as part of their obligation as a students in university or only for full filling the requirement to achieve higher level of career advancement [5]. The worse is that there are about 3.51% of her respondents admitted they did falsification by bought the CAR research report.

Another study did by Defina, Aisah, and Qolbi [6] stated that many teachers having difficulties in conducting CAR for some reasons: teachers are lack of information and skill for conducting CAR; teachers do not have much time to conduct CAR because of having much teaching hours; and teachers do not have many access to joint workshop or training about CAR. In addition, many teachers having problem doing literature review this condition resulted from their literacy culture. In following the situation many teachers are very weak in constructing scientific sentences in their research report [7]. This finding is still relevant with study did by Burns and Rochsantiningsih [8] in the year of 2006 that stated there are three main problems for teachers in conducting CAR: general problem constitutes of time management; research problems constitutes of formulating and focusing problem, recognizing important aspect developed in the research, planning, acting, monitoring and reflecting, planning next cycle and writing research report; individuals problems such as lack of motivation, confident, and energy, criticism from seniors and colleagues and conflict with school authorities. Another problem that faced by teachers who already conducting CAR is that they do not have mentor or facilitator as an expert that competence in guiding them when they face problems [5].

Realizing that CAR is an important part of CPD program for teachers and there still many teachers who need help for conducting this scheme [9]. There are many agencies that interested to take part in helping the teachers by conducting project which focus on teachers’ professional development program as part of education reform policy [10]. One of agencies that focus on education is Tanoto Foundation. This is a philanthropy organization founded by Tanoto Sukanto, an entrepreneur from Indonesia who concerns in the improvement of education quality in Indonesia. Through the project called as “Classroom Action Research: Collaboration between Teachers and Lecturers” Tanoto Foundation would like to try to contribute in solving the aforementioned problems.

This paper is a part of bigger ongoing study which focus on enhancing the ability of Mathematics, Science, Social, English, Bahasa teachers in conducting CAR through PD program by collaboration with lecturers and school supervisors that would like to answer the research questions: (1) How to design PD program for mathematics and science teachers in Indonesia through collaboration CAR between teachers, lecturers and supervisor? (2) How the process of collaboration between teachers’
researcher, lecturers’ researchers and other components of collaboration CAR as a part of PD program for mathematics and science teachers?

2. Method

As this paper want to on specific object and processes in specific context, a design research is the suitable methodology for the study [11]. A “design research” method adopted for analyzing the process of PD program through collaboration CAR. Due to that this study using design research method forward to produce processes and tools that work well in practice with facilitator as trainer and teachers, lecturers and supervisors as targeted group so considerably the engineering research approach is the most relevant approach for the study [12]. In the process of designing the structure of the workshop and the material for the workshops experts from at least three elements were involved: (1) an expert consultant from government who involved in articulating policy for career advancement of teachers; (2) two practitioners from agency who experienced in designing and conducting educational workshop; (3) four experts from mathematics and science education department from three different universities who theoretically competence in concept of CAR.

This study is conducted in five province of Indonesia: Central Java, Riau, Jambi, North Sumatra, and East Borneo. The participant in this study are: mathematics and science teachers, lecturers from mathematics and science education department and school supervisor for elementary and junior high school. Each of them has a different role in a group. The detail information about the participants are available in Table 1 and Table 2.

| Province            | Teachers (Researcher) | Lecturers (Researcher) | Teachers (Observer) | Lecturer (Observer) | Supervisor (Observer) |
|---------------------|-----------------------|------------------------|---------------------|---------------------|-----------------------|
| Central Java        | 1                     | 1                      | 1                   | 1                   | -                     |
| North Sumatera      | 1                     | 1                      | 1                   | 1                   | 1                     |
| Jambi               | 2                     | 2                      | 2                   | 2                   | 2                     |
| Riau                | 1                     | 1                      | 1                   | 1                   | 1                     |
| East Borneo         | 1                     | 1                      | 1                   | 1                   | 1                     |
| Total Sum           | 6                     | 6                      | 6                   | 6                   | 4                     |

There are six groups of mathematics teams, three groups are in elementary level and the other are in junior high school level. The total number of participants for mathematics teams from five provinces are 30 participants.

| Province            | Teachers (Researcher) | Lecturers (Researcher) | Teachers (Observer) | Lecturer (Observer) | Supervisor (Observer) |
|---------------------|-----------------------|------------------------|---------------------|---------------------|-----------------------|
| North Sumatera      | 1                     | 1                      | 1                   | 1                   | -                     |
| Jambi               | 1                     | 1                      | 1                   | 1                   | 1                     |
| Riau                | 1                     | 1                      | 1                   | 1                   | 1                     |
| Total Sum           | 3                     | 3                      | 3                   | 3                   | 2                     |

There are three groups of Science teams from three different province with the total number of participants are 15. Data in this study were collected through observation, interview, group meeting and learning logs, then the data were analyzed using grounded theory approach through the process of open, axial, and selective coding.
3. Results and Discussion

3.1. Design of Collaboration CAR between Teachers, Lecturer, and Supervisors.

The process of designing and developing the concept for workshops started April 2019 until July 2019. In line with the research questions in this study, the workshop are held in term of groups’ context. In every group consisted of two teachers, two lecturers, and one supervisor except for West Java and North Sumatera provinces. Every team has a facilitator who is an expert of guiding teachers doing CAR. The structure of the workshop are designed in two types, national workshop and provincial workshop. There will be three national workshops and three Provincial workshops. In every workshop there is a module that has been designed based on the theory of CAR and based on PerMenPanRB number 09 in year of 2009. The structure of the workshop are described in Figure 1.

Figure 1. Structure of The CAR Workshops.

In national workshop, the participants are consisted of teacher researcher and lecturer researchers. The lecturer observer, teacher observer, and supervisor are invited only in provincial workshop, however in the first provincial workshop the role of those participant were not determined specifically yet until the work shop were held.

Every workshop, both national and provincial, is completed by a set of module that designed based on the aims and the target of the workshop. These modules were tailored by expert and practitioners who involved in preparing and formulating the design. While this paper is being presented, the project is still goes into the stage of provincial workshop 3 that take place in 5 provinces.
3.2. The process of collaboration between teachers, lecturers, and supervisors in doing CAR as a part of PD program.

In first national workshop which is held in Jakarta on 12-15 July 2019, the participants are mathematics and science teachers from all provinces and lecturers researchers as their companions. In this first national workshop, the main focus is to change teachers’ mind set about doing CAR. Teachers have to realize that the aim of doing CAR is not only for fill the requirement of career advancement process but for improving the teaching and learning process as well as learning outcomes. By improving the teaching and learning process, their career advancement can also improve automatically. In the first national workshop teacher and lecturer were working in pair to identify problems in the classroom. Based on data from observation and interview, in this process lecturer were very dominant in determining which problems that suitable for their CAR. Many teachers still afraid of giving opinion and relied on the lecturer ideas. Most lecturer tend to infiltrate the teachers’ opinion in the process of identifying the research problem and formulating the solution of the problem. On the other side, all mathematics and science teachers also do not have enough confidence for doing CAR.

The result from national workshop-1 are list of topic that have been proposed by 6 pairs from mathematics teams and 3 pairs form science teams. The detailed information is listed in Table 3.

| Province        | Topics for Mathematics Teams                                                                                                                                   | Topics for Science Teams                                                                                                                                       |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Central Java    | The use of bottle cups to improve elementary students’ ability in doing multiplication                                                                         |                                                                                                                                  |
| North Sumatera  | The use of number card for improving students’ learning outcomes in the topic of two digit numbers multiplication                                              | Implementation of Contextual teaching and learning model for improving self-efficacy and students’ learning outcomes |
| Jambi           | • The use of algebraic cards for improving students’ understanding in finding the roots of quadratics equations                                                | Improving students’ literacy in science using discovery learning model modified by Muaro Jambi context                                                  |
|                 | • The implementation of role-model strategy for improving students’ understanding the concept of addition in real life situation                              |                                                                                                                                                                    |
| Riau            | The implementation of Scaffolding technique for improving students’ learning outcomes in the topic of power index and roots                                    | Improving students science reasoning ability through the implementation of guided inquiry model                                                              |
| East Borneo     | The use of manipulative for improving students’ outcomes in the topic of operation of positive and negative integers                                          |                                                                                                                                                                    |

The provincial workshops-1 were held in every province in August 2019. The number of teams’ member are increasing because teacher, lecturer, and supervisor were involved. Based on the previous data from national workshop 1, due to the number of lecturers are increasing in every team, so that an anticipation is carried out to prevent the situation in which lecturers will dominate the whole process by giving platform for lecturers to guide the teachers through three stages: (1) giving three appreciation; (2) giving two questions; and (1) giving a solution for teachers during the workshop sessions. Because of the role of observers in every team have not been determined yet in the design, so
that in the provincial workshop-1, at the beginning they seem not actively involved in the first and second session of the workshop. Realized that the condition were not effective then the facilitator initiated to involve those member by giving responsibility to criticize the work of the researcher and give feedback for lecturer observer and giving responsibility to help teacher researcher completing the tasks. Data from this workshop showed that some lecturer observers still have different understanding about the concept of CAR theoretically and the concept of CAR based on PerMenPanRB number 16/2009. Some debates arose about the topic of achievement indicators, method, and cycles between lecturers researchers, lecturers observers and teachers researchers, but then the facilitator explained that there are some differences between concept of CAR theories in some textbooks and concept of CAR in PerMenPanRB, because the workshops focus on how to doing PD through CAR for teachers so the participants have to agree with the version of CAR from PerMenPanRB.

The provincial workshops-2 were held in September 2019 in all provinces. This workshop were focus on doing data analysis and reflection of cycle-1. Based on the data observations and interviews, there found some misconception about: (1) determining achievement indicators in previous workshops; and (2) determining the type of instruments based on the aims of the study. Five out of nine teams having misunderstanding in stating the achievement indicators, three of them made the indicators not operational to be measured and two of them they stated the indicators but they did not provided the instruments for gathering data, so it was difficult to determine whether the intervention has been success or not yet. A team from science found that the instrument they designed were set in line with the theory of intervention they did and the outcomes they wanted to be achieved. In these workshop the relationship between teachers, lecturers and supervisor become better. All the member of team already equal responsibilities based on their roles. The lecturer researchers showed that they could guide the teachers to become more independent and more confident in conducting some tasks. The teachers’ participants more active in devoting their ideas and argumentation. Only few supervisor that still become passive member in giving ideas during the discussion. In mathematics elementary teams, this situation occurred because they do not have mathematics education background. In mathematics junior high school team, the supervisor actively involved in discussion.

Until this paper written, there are two out of five provinces that have been conducting provincial workshop-3, Central Java and North Sumatera consisted of three teams. In central java province, the team has misunderstanding about concept of cycles in CAR. They did the interventions, teaching similar topic both in cycle-1 and cycle-2, they repeated teaching the same topic for four times in two cycles. The misunderstanding related to determining achievement indicators still appeared. Most of them though that CAR need to have both achievement indicator related to learning process and learning outcomes. Based on data observation, the skill of writing academic sentences of teachers significantly improved, it can be seen from their result of writing. This result in line with finding from Garces and Martinez [13] that stated collaboration classroom action research can help teachers to understand the basic concept and also and write journal article. The role of observer in this workshop were helping researcher to find the sources for literature reviews. The others provincial workshop-3 will be held in the end of November 2019.

After four stages of series workshops, a certain result is that the research community has been created automatically. As stated by Bruce [14], this model of CPD can help teachers to alleviate the feeling loneliness when doing CAR. The issue about insecurities of the teachers as researchers in collaboration CAR that show up in the first national workshop-1 supported the finding of study did by Bruce [14] and can enriched the literature review about this topics. Through this model, problems related to teachers’ commitment as stated by Levin and Rock [15] can be handled very well.

4. Conclusion
Even though there still some participants have misunderstanding about the process conducting CAR, but through the collaborative CAR those cases easily to detect and repair. In general, the conclusion of the ongoing project are that the PD program through collaborative CAR model consisted of six consecutive workshop that constitute of three national workshops and three provincial workshops with two independent working groups discussions outside the workshops that consisted of three main components: teachers and lecturers as researchers, teachers and supervisor as observers. In addition,
the process of collaboration in conducting CAR as a part of PD program automatically creates researchers community between teachers-lecturers-supervisors. Another issue arisen in the process of collaborative CAR is the roles of every member of the community.

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