Microscience Experiment: The Idea Of Improving In-Service Science Teachers' Training Quality At Balai Diklat Keagamaan Bandung, Indonesia

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Abstract: Microscience approach is a new and highly innovative practical science concept that use a very small scale or microscale. It has a lot of advantages over the tradition approach which is cheap, easy to store, and easy to clean, as well as save hazardous waste disposal because uses microscience kit. The integration of practical work with the theory may have contributed to the positive response of conceptual understanding, of course Microscience approach is aiming to provide science teachers' training. This article will discuss the implementation of microscience approach as a model for improving in-service science teachers' training quality at Balai Diklat Keagamaan (BDK) Bandung.

Index Terms: Microscience, microscale, microchem.

1 INTRODUCTION

Teachers play an important part for improving learning quality and because of they are the central in learning process, of course improving their competences is a must through on-going and continuous teachers' training. BDK Bandung is training institution for all Ministry of Religious Affair (MORA) employees in West Java province, a kind of MORA employees are the Islamic schools' teachers. Upgraded training for MORA employees is a part of BDK Bandung duty, as a mean to raising their skills so they can work properly. Because of this official role, BDK Bandung must think about their main task and function to fit the user expectations. As an example is reviewing content in science teachers' training curriculum to focus on more practical activities rather than the delivery of information. It is recognized by the in-service science teachers' training evaluation that teaching and learning process has been done over relying on lecturing, which is based on the curriculum and the teacher, while the implementation of learning through learning by doing or do some science experiments is very rare. Furthermore, science teachers are hoping to obtain the knowledge and skills to use the simple laboratory equipment when they take part a training because they admit that several designed experiments in learning science have objective to facilitate students in directly linking science concepts with the experience of nature. In addition, some Islamic School (Madrasah) have science experimental tools (Science Kit) but it was apparently only made it as a display device alone. So that, it would be more useful if the training is not just a refresher or getting additional material science but is also followed with the simple practical works experience or doing experiments. It would be valuable in order to make it easier for teachers to achieve the science learning objectives that they will plan, increase knowledge and motivate learners with the growth of new discoveries in technology and overcome the gaps between theory/concepts and facts in science.

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Therefore, the task of developing a science teachers' training process at BDK Bandung more emphasis to improve motoric skills even though there are a few things that should be solved firstly, such as laboratory facilities and infrastructure problems. As one alternative solution, this paper will explain the idea of microscience that is the using of plastic laboratory equipments, small size, simple, easy to clean and washable (microscience kit).

2 LITERATURE REVIEW

2.1 Microscience Concept and Implementation

Microscience is an alternative approach in science practical work that using microscience kit. Microscience kits and teaching materials have been developed in South Africa by the UNESCO associated Centre for Microscience Experiments, located at the Witwatersrand University, Johannesburg (http://www.radmaste. org.za/). The kits have been specially formulated for use in developing countries. They are small, virtually unbreakable and inexpensive, and have been designed to enhance the quality, relevance and accessibility of science and technology education, also to involve the community in applying the science for their life. The initial development of the microscience approach by cooperation UNESCO and IUPAC (International Union of Pure and Applied Chemistry), focused on secondary school needs, particularly in chemistry. Providing practical experiences in chemistry is a priority because chemicals are consumables, giving rise to high running costs and significant hazard and environmental impact. Microscience kit developed for chemistry lab named Microchem (Akoobai & Bradley, 2005; Priest, 1999). The main microchem equipment is comboplate that is an instrument of not translucence rectangular plastic plates measuring 125x80x20mm which there is a cylindrical hole 60 consists of 12 large holes and 48 holes are smaller and can be used according to its function as a test tube or glass beaker. The using of microchem was accepted and widely known in South Africa mainly for school as described above and also use in the first year college level. About 400,000 packages have been distributed to all district in South Africa and the socialization of the utilization this tool has spread outside of Africa, such as Bangladesh, Hong Kong, Brazil and Ireland (Akoobai &Bradley, 2005). Bradley found that the chemistry lab using microchem as a form of microscience application can be used as an alternative implementation of chemistry experiment in a condition of funding, laboratory, equipment and materials are

limited. Research on practical implementation using microscience in South Africa showed a positive attitude to support the implementation of practical work. In addition, there were also an increase in the mastery of chemical content d from student practical work experience using microchem (microchemistry kits) so Akoobai and Bradley concluded that the success of science learning is not depending on the sophistication of laboratory equipment. In addition Silawati (2006) has highlighted several advantages microscience approach. Firstly, the microscience equipments are in small size, so the lab materials used are very small (mg, ml), made of plastic, reusable, the equipment can be used by several people, safe and environmental friendly, easily packaged therefore be implemented at home. In Indonesia, the introduction microscience have been undertaken by UNESCO in cooperation with The Central of LIPI in Jakarta (Silawati, 2006) in an activity called 'UNESCO/ISESCO Training on Microscience Experiment and DIDAC". The training was attended by 32 participants consisting of biology and chemistry teachers in the Jakarta area and surrounding, and also from college lectures followed by the Open University and the Institute of Technology Bandung. From practical experiment using microscience approach, it is concluded that the lab with small scale (microscale) may be a means to obtain practical experience and enhance knowledge and understanding of the concepts of science in general and chemistry in particular for training participants.

2.2 Improving Science Teachers' Competences by Using Microscience

It has been recognized by the science teachers that science is a subject that expect students have well organized knowledge, ideas and concepts gained from nature through a series of scientific process, including the investigation, preparation and presentation of ideas (Subiyanto, 1988). In the Natural Sciences, students are required to understand the concepts of Natural Sciences, through the activities of observing to make conclusions, so formed a critical and scientific attitude. In fact can be seen that the process of Natural Sciences teaching and learning in schools, many teacher deliver material in a traditional with lecture method. Several studies indicated that the level of Natural Science mastery learning only reached less than half of the ideal curriculum demands. If we look closely to address the above problems, it has many stakeholders in education trying to solve the low quality of Natural Science education problem. For example, innovation, upgrading, training, research, reviewing curriculum. Along with technology development, utilization of multimedia to replace the role of the laboratory has been developed using computer simulations. However, pratical work with computer simulation have limitations which cannot simulate the role of a scientist in the experiment. Giving practical work experience in learning science is something that should be done as proposed by Lunetta and Hofstein (1980, in Akoobai and Bradley, 2005), which adopted the 3 domain of the Bloom theory in the learning. The first domain is cognitive which refers to laboratory activities will provide the experience and the introduction of the science concept and scientific method. The second domain is psychomotor, useful for the development of motoric skills such as caution, careful observation and creates a sense of responsibility. The last is affective domain to develop confidence and curiosity attitude so that worry in carrying out practical work can be avoided. Thus, the development and implementation of practical work in the learning science process can support the three domains above and will contribute to the development of students' logical reasoning. Besides that, students will gain a level of understanding the material better through the practical work experience because the practical work has several goals such as (Woolnough & Allsop, 1985 in Akoobai & Badley, 2005):

- **a)** Evolving curiosity
- **b)** Learning the techniques and skills
- **c)** Studying the processes that take place in science
- **d)** Supporting the concepts and theories contained in textbooks.

It is supported by Chandler & Barnes (1981) who said that science without practical work is meaningless not because its benefit. It is more important that they will gain practical skills during or after the practical work process that are recorded in their memories.

3 Analysis Methodology

The analysis conducted in this study is a qualitative analysis by reviewing the conceptual relationship between variables based on causal effectual analysis approach. The author acts as a participant observer, the analysis is done by observing and evaluating the various phenomena that occur on the object of research, and then carrying out the discussion of the phenomenon based on the logic of the author who later confirmed the theoretical framework in the literature and/or research results that are relevant to the main topic of this study.

4 Result and Discussion

There are several reasons why only a few science teachers develop practical work in their learning process. First of all, it is due to limitation of facilities and infrastructure. Facility and infrastructure development that support science practical work activities, of course it need great budget. The great cost is not only for building representative laboratory but then thinking about safety storage for laboratory equipments and chemistry materials so that is safe and non-threatening people. On the other hand, laboratory apparatus must be handle with care because most of them made by glasses and expensive price. This issue causes BDK Bandung doesn't have a representative science laboratory until now that can be used as a training center by science teachers. Except facilities and infrastructure problems, based on interview with science teachers as training participants, they said that their schools got government grand such as science kit. Unfortunately, these tools are not used yet optimally because science teachers did not train yet when those equipments delivered to schools. So that, training participants addressed to get enough training material examples about practical work in particular how to use science kit. This issue becomes seriously attention for BDK Bandung trainers and also the institution for answering this challenge. Of course, BDK Bandung is a training organizer that needs to review its training curriculum. Science teachers' training content necessary include microscience method for expanding practical work skills so that participants will get more an understanding of science concept which is useful for them to facilitate their student in learning process. In addition, BDK Bandung do not forget to also develop training activities or the use of science kits workshop for science Islamic schools

teachers and generally many basic education Islamic schools has had equipment like this. Practical work activities in science teaching is a integrating form of direct practice students' experience with their content understanding through teacher and textbooks. It also allows the students to share knowledge, discuss its results and work in groups. So, the importance of activities in practical works science teaching and learning process has implications for the readiness of the science teachers for preparing practical work-based science learning and BDK Bandung as a training teachers place to be able to carry out their duties as best as possible. The idea uses microscience method can be the answer to overcome the difficulties associated with the facilities and infrastructure that support practical work activities both in BDK Bandung and Madrasah-religious schools teachers on duty. Firstly, BDK Bandung needs to budget the purchase microscience kits and to involve the science trainers to attend training. Furthermore, the trainers can dissemination microscience kits as learning science media into every madrasah in west Java Province or include material microscience kits as learning science media in science teachers' training. It is expected to encourage the teachers to have tools like this by supporting each madrasah invest their budget for buying it. Additionally, BDK Bandung may be able to learn from the experience of the Open University/Universitas Terbuka (UT) or Higher Education Distance Learning/Pendidikan Tinggi Jarak Jauh (PTJJ). UT or PTJJ have tried to apply microscience for first year students who take science courses and other program to improve the quality of teachers. PTJJ's students who take science courses certainly getting difficulties in implementing practical work because not the whole place to learn is equipped with a laboratory room. Although since 1990 UT has sent a chemistry tool kit for two years teachers' college students (D2 Teachers' Education Program) available at the college nearest their residence. However, it is also constrained by regulation shipments of chemicals, therefore the application microscience be an alternative solution (Silawati, 2006). BDK Bandung can be adopted PTJJ's way to organize students to practice using microscience kits with face-to-face tutorials, following the development of the audio or practical works' simulation using microscience kit as introduction before students do its practical work. So, BDK Bandung in advance should train the trainers and then they can disseminate to the science teacher. The development of audio-visual and microscience kit guidebook can also be the key task of science trainers at BDK Bandung for improving their competence. Of course, in-service teachers' training becomes more attractive if this can be done over the next years because they have been able to improve their teaching and learning process, which impact on the raising ability of students in science subjects.

5 Conclusions and Suggestions

5.1 Conclusions

Microscience method can be used as an alternative science practical work at BDK Bandung as the in-service science teachers' training organizer or in Islamic Schools. It is useful for handling with the limitation of laboratory facilities in there.

5.2 Suggestions

a) BDK Bandung should have budget for buying microscience kit and facilitate their science trainers to follow microscience workshop.

b) Science trainers should increase their skills of teaching and learning media, especially to support science practical work in in-service science teachers' training process.

c) BDK Bandung should include microscience and science kit as a teaching and learning media in its curriculum of in-service science teachers' training.

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