

Active Learning to Improve Fifth Grade Mathematics Achievement in Banten

Andri Suherman,^{a,*} Soesaptri Oediyani,^a Ika Handayani,^a Lia Uzliawati,^a
Ina Indriana,^a and Darlaini Nasution^a

^aUniversity of Sultan Ageng Tirtayasa, Indonesia

Abstract

Teaching for active learning is a pedagogical technique that has been actively promoted in Indonesian education through government reform efforts and international development assistance projects for decades. Recently, elementary schools in Banten province received training in active learning instructional strategies from the USAID-funded project, Decentralized Basic Education 2. Post-training evaluations conducted by lecturers from the University of Sultan Ageng Tirtayasa (UNTIRTA: *Universitas Sultan Ageng Tirtayasa*) suggested that teachers were successfully employing active learning strategies in some subjects, but not mathematics. In order to understand the difficulties teachers were having in teaching for active learning in mathematics, and to assist them in using active learning strategies, a team of lecturers from UNTIRTA designed and carried out an action research project to train teachers in an elementary school in the city of Cilegon to use a technique called Magic Fingers in teaching Grade 5 multiplication. During the course of the project the research team discovered that teachers were having problems transferring knowledge gained from training in one context and subject to other school subjects and contexts.

Abstrak

Model pembelajaran aktif atau *active learning* merupakan metode pedagogik yang sering dipromosikan di Indonesia melalui program perbaikan mutu oleh pemerintah dan proyek pendampingan oleh lembaga internasional. Baru-baru ini, beberapa sekolah dasar di Propinsi Banten mengikuti pelatihan strategi pengajaran *active learning* melalui proyek bantuan USAID, Decentralized Basic Education 2. Evaluasi paska pelatihan, yang dilaksanakan oleh para dosen dari Universitas Sultan Ageng Tirtayasa (UNTIRTA), menilai bahwa para guru telah sukses mengintegrasikan strategi *active learning* pada beberapa mata pelajaran atau mapel, kecuali Matematika. Guna memahami kesulitan para guru menerapkan *active learning* di kelas Matematika, dan membantu guru di sekolah dasar di Cilegon menerapkan strategi pengajaran ini, maka tim dosen UNTIRTA mendesain dan melakukan penelitian tindakan kelas, yang bertujuan agar guru berlatih mengaplikasikan teknik Magic Fingers untuk materi perkalian di kelas 5. Tim menyimpulkan, para guru kesulitan dalam mentransfer konsep *active learning* dari mapel dan konteks yang dipelajari selama pelatihan ke mapel lain dan konteks sekolah masing-masing.

Key Words: Mathematics, Teaching for Active Learning, Indonesia, Banten

Introduction

From Indonesia is a developing country that has many goals yet to be achieved. One of these goals is improving the quality of human resources by paying more attention to education. According to Section 28 of the Indonesian Constitution of 1945, the national educational system is charged with ensuring that all

Indonesians receive a good education designed to increase their competence in life skills, their responsibility, and their dignity as human beings. School curricula should enable Indonesians to be competitive and ready to face life in an era of globalization. To better accomplish these goals the government of the Republic of Indonesia has, since the end of the Suharto era, embarked upon a policy of decentralization which seeks to enable educational policies and practices that are more responsive to the needs of local communities and individual learners (Bjork 2003). In keeping with the thrust of decentralization, the Ministry of National Education has, for instance, undertaken initiatives such as

*Corresponding author. Address: Faculty of Engineering,
Sultan Ageng Tirtayasa University, Serang, Banten, Indonesia.
Email: adris_mada@yahoo.com.

the Educational Unit Level Curriculum¹ (KTSP: *Kurikulum Tingkat Satuan Pendidikan*), which gives each school the authority, within nationally established guidelines, to devote 20 percent of its curriculum to local needs and interests, and Active, Creative, Effective and Joyful Learning (*Pembelajaran Aktif, Kreatif, Efektif dan Menyenangkan*), an effort to promote teaching for active learning in Indonesian schools. Such government initiatives have also been supported by major international assistance projects, such as the USAID-funded Decentralized Basic Education 2 (DBE2), which, among other goals, aimed to improve teaching and learning in the primary schools of eight provinces by improving teachers' content knowledge and promoting teaching for active learning. Thus active learning has been a key element of recent efforts to improve teaching in Indonesian schools.

Active Learning

While active learning remains a topic of considerable interest in contemporary educational research and reform, it is an approach to teaching with a history that goes back at least as far as Rousseau (1762/1979) and which finds support in the work of educational theorists such as John Dewey (1900), Maria Montessori (Rusk and Scotland 1979), Lev Vygotsky (1978), and Paulo Freire (1970/2001). According to Hannele Niemi (2002), the common feature of active learning "is the learner's active impact on learning and a learner's involvement in the learning process" (764). While there is a wide variation of meanings attached to the term active learning—from simply more individual response to questions to group work to greater student control of their own learning—key characteristics of active learning include student involvement in more than listening, more emphasis on the development of skills, student engagement in activities, and an emphasis on students' exploration of their own attitudes and values (Keyser 2000; Farrell and Mfum-Mensah 2002). It is often defined in contrast to more traditional methods of teaching in which knowledge seen as something transmitted from teacher to student (Bolhuis and Voeten 2001).

Teaching for active learning is thought to be more attractive to learners, to facilitate the connection of learning to student needs and interests, and to enable children to learn how to learn, an increasingly important skill in a modern world with what is frequently described as a knowledge economy (Simons 1997). Various components of active learning strategies have found support in a wide array of research studies going back almost 90 years (Prince 2004), with studies showing its effectiveness in the sciences and social sciences (House 2008), in promoting cross-cultural understanding (Firlik 2000) and student retention

(Woolman 2002), and in fostering democratic social behaviors in schools (de Baessa, Chesterfield, and Ramos 2002). Unsurprisingly, given the widely-held consensus on the efficacy of teaching for active learning, the strategy features prominently in pre-service teacher preparation programs (Aubusson, Ewing, and Hoban 2009; Olgun 2009).

While teaching for active learning has long been a strategy promoted, if not always practiced, in the educational systems of developed countries (Stern and Hüber 1997), its promotion has become an increasingly common feature of international educational development efforts in countries as diverse as Finland (Kimonen and Nevalainen 2005), India (Woolman 2002), Guatemala (de Baessa, Chesterfield, and Ramos 2002), Macedonia (Sturtevant and Linek 2007), and Egypt (Herrera 2008). As mentioned above, Indonesia too has promoted teaching for active learning as a mechanism to improve the quality of teaching and learning in Indonesian schools. Many of these studies, however, have discovered serious impediments to the widespread adoption of active learning pedagogies (Niemi 2002; Organisation for Economic Co-operation and Development [OECD] 2009), including in Indonesia (Bjork 2003).

The authors of this study, several of whom were directly involved in the training provided under DBE2, learned of teachers' difficulties with teaching for active learning in the course of their follow up assessments of DBE2 training in Banten. In order to better understand the difficulties teachers who had received active learning training were having in actually teaching for active learning and to assist them in a utilizing that training in their own classrooms, a team of lecturers from the University of Sultan Ageng Tirtayasa (UNTIRTA: *Universitas Sultan Ageng Tirtayasa*) in Serang, Banten Province, designed and carried out this action research project.

Research Site

Banten is a new province located on the western tip of the island of Java. It consists of nine regencies and cities, one of which is the city of Cilegon, a major industrial city famous for the steel industries that give it its nickname—"Steel City." The most famous of these is PT Krakatau Steel, one of the largest industries in the country producing steel for domestic use and export. Despite its emphasis on heavy industry, however, Cilegon is also home to some of the most popular beaches in Java. It is also close to the provincial capital of Serang, the home of UNTIRTA. The UNTIRTA action research team, therefore, selected a government elementary school in Cilegon—Sekolah Dasar (SD) Bendungan I—as the site for the action research project described here.

SD Bendungan I is located in a suburb of Cilegon about five kilometers from the city center. It enrolls approximately 240 students in Grades 1-6. The school facilities are somewhat smaller than other government elementary schools in Cilegon. They include six classrooms as well as a principal's office, administration room, library, teachers' office, and prayer room (*mushola*). The school is surrounded by a furniture-making shop, a coffee shop and a traditional restaurant. The noise from these businesses often interferes with students' concentration in the classroom.

Success in teaching and learning involves students, teachers and parents, as well as external actors such as the community and relevant government bureaucracies. Students, of course, must be committed to learning, but parents, who guide and control students' activities at home, are also important. Parental involvement however is often influenced by social and economic circumstances. The parents' of SD Bendungan I, for instance, are middle to lower class, with many employed as porters in the traditional market near the school. Their income, therefore, fluctuates from day to day. The SD Bendungan I school committee attempts to compensate for this fluctuation in parental support by carefully managing the school operating fund supplied by the government. Some of the teaching staff, who either teach self-contained classrooms or specialty subjects like English, religion, or sports, experience their own forms of financial insecurity as some are civil servants, with guaranteed employment (Bjork 2003), while others are contractual employees whose employment is dependent on the sufficiency and management of the school operating fund.

All of the civil service teachers of SD Bendungan I have received training in classroom management and active learning from the USAID-funded project DBE2. This training encouraged and enabled teachers to be more creative and active in managing the classroom, especially in the preparation of effective teaching and learning activities. A major component of this training was teaching for active learning, a new paradigm for these teachers in that it encourages them to see themselves as good facilitators that make learning enjoyable and motivate students to be more active in their own learning. This contrasts with a traditional approach to teaching that emphasized teachers' skills as lecturers but left students as bored and passive learners. Active learning on the other hand encourages students to be active in the classroom rather than just good listeners. Active learning strategies particularly encourage teachers to recognize that students are different from one another and unique, with their own characteristics and learning styles which should be attended to in teaching. Students are not objects to be controlled by teachers in active learning but subjects who have a variety of competencies, unique

characteristics, an individual imagination and a future that must be enhanced if the nation is going to reach its goals. Such principles are entirely consistent with the teaching strategies promoted under the KTSP curriculum reform.

Methods: Action Research

The process of teaching and learning in any setting can often encounter barriers that disrupt teachers' plans, students' achievement or the school's goals. In such circumstances it is necessary for teachers and others to investigate the nature of the problems that arise and seek solutions through further training, if warranted, or through action research. Ernest Stringer (2007) describes action research as a systematic investigation into problems that come up in education or other social endeavors which then informs careful experimentation with likely solutions to those problems. In this fashion teachers, or other practitioners, are able to more fully understand the problems they have encountered, prepare a likely solution to them, and evaluate the results. If the results are successful, then the practitioner can move forward. If not, then those results constitute relevant data for another cycle of inquiry.

Therefore, in order to better understand the successes and difficulties the teachers at SD Bendungan I have encountered in teaching for active learning and, if necessary, assist them in that process, the UNTIRTA action research team designed and carried out a collaborative action research project with selected teachers at SD Bendungan I. Over a period of eight months the research team conducted classroom observations, interviews, and focus group discussions with the school principal, teachers, parents, and students designed to gather data on the difficulties and successes teachers at SD Bendungan I were having with teaching for active learning. Classroom observations were recorded for later analysis by the team. Interviews and focus group discussions were recorded and transcribed. All three forms of data were managed according to Matthew Miles and A. Michael Huberman's (1994) matrix analysis technique. This involved data reduction—observation, interviews, field notes, and testing—and data display, analysis of the results of observations, interviews and field notes. The data was first analyzed holistically, to identify broad themes that appeared to be emerging from the data, and then categorically, to try to understand the particular elements of these themes. The results of data gathering and analysis were then used to inform classroom interventions intended to assist the selected teachers in resolving the particular difficulties they were having. The research team conducted two cycles of data gathering, analysis, planning, intervention and reflection.

Problems and Successes with Active Learning at SD Bendungan I

Charles C. Bonwell and James A. Eison (1991) note that teaching for active learning is facilitated by the use of things like audio-visual materials, discussions that help students learn how to deliver arguments and make decisions, collaborative group activity, peer tutorials, problem-solving activities, activities outside the classroom, and prompt feedback on students' work. Based on the research team's interviews and focus group discussions with the teachers of SD Bendungan I, however, they do not have adequate supplies of audio-visual aids or other learning tools and their heavy teaching loads, as well as the socio-economic circumstances of their students and parents make teaching for active learning difficult. Parents lack the resources to help their children and their children's teachers develop their own learning materials out of even inexpensive and readily-available materials. Students are often unprepared themselves to fully understand and participate in active learning strategies, and some teachers themselves still see only the "fun" part of active learning without fully comprehending its relationship to effective learning. These problems are exacerbated by lack of books and other references, lack of money, and at times lack of appropriate administrative support.

Interviews with the principal, teachers, parents and students reveal a number of similarities, but also differences of opinion on the general problems the school faces. All four groups thought that the school facilities, number of books, school management, student participation, and teachers' involvement were satisfactory or good. Interestingly, all four groups said they felt the use of active learning strategies was satisfactory or good. Parents and students answered good or satisfactory on all ten potential problem areas. The only divergences among the four groups were with the principal, who reported that school finances were inadequate, and with the teachers and the principal, who reported that parental involvement and the availability of instructional media were both inadequate. Thus everyone seems to be more or less satisfied with their own performance, locating any problems that the school faces outside the school with parents and the government, neither of which provides the support that teachers and the principal feel they need.

Despite this, the teachers of SD Bendungan I have tried hard to implement active learning principles in all subject areas, even though their DBE2 training addressed only science, English and social studies. One teacher reported, "I have used active learning in mathematics, where I use a scale to teach kilos and grams, in social studies, where I ask students to make maps from newspapers, in civic education, where students role play positive

and negative behaviors, and in Bahasa Indonesia, where students read conversations and act them out" (Teacher 1 Interview with the authors). The success of their efforts is borne out in the research team's observation of one science classroom.

The lesson in this Grade 5 science class was magnetism. After greeting the students and joining them in prayer (both teacher and students are Muslim and Indonesian law permits organized prayer in government schools), the teacher, Ibu Asliah (psuedonym), introduced the topic and divided the students into two groups. Two representatives from both groups were instructed to remove matches from a glass using an object that was covered so that students could not immediately identify it. They discovered that some matches could be moved while others could not. Ultimately, Group A was able to remove more matches than Group B and thus won the "competition." After the exercise was over, the teacher asked the students why they were able to remove some matches from the glass while others were not able to do so. Students offered various hypotheses to explain what they had witnessed: There was some "material" in the covered object. There was a strong "drag" associated with it. Some thought the covered object was glue. Another suggested that the object had magnetic powers.

Ibu Asliah wrote each of the students' hypotheses on the white board, remarking "we haven't quite gotten the correct answer." She then asked the students to conduct an experiment to test their hypotheses. A group leader was assigned to organize his or her group. The students designed and carried out their experiments, carefully noting their observations and then discussing their results. While students were performing their experiments, the teacher circulated around the class questioning each group about their findings. The students were then asked to present their findings to the class while their classmates asked questions. At the end of the process, the students concluded that there were some things that could be moved with a magnet and some things that could not. They described those things that could be so moved as magnetic and those that could not as non-magnetic. They then demonstrated that some of the matches could be moved because there was a small nail inside them. Ibu Asliah concluded the demonstration with a discussion of the various uses of magnetic materials and then asked for questions. There were no questions.

While this vignette does not demonstrate that all SD Bendungan I teachers have mastered teaching for active learning in science, it does suggest a degree of success in this particular subject matter, which was, not coincidentally, explicitly addressed in DBE2 trainings. Teachers reported less success, however, in mathematics, which was not part of the DBE2 training in active learning strategies and where students' test scores were lower than expected. Students reported that mathematics was difficult for them: "I like Bahasa Indonesia and reading, but I do not like math.

It's difficult" (Student A Interview with the authors). Another said, "I like science. I love to experiment, but math . . . no, it's difficult" (Student B Interview with the authors). And parents' confirmed their students' difficulties with math. One reported, "My daughter is always complaining about learning math. She finds it difficult to understand" (Parent Interview with the authors).

In order to determine the nature of the difficulties students were having in mathematics, the research team administered a pre-test to 82 students in Grades 4 and 5. The results of the pre-test suggested that students were having difficulty with multiplication, especially the multiplication of two-digit numbers. Few students had problems with simple multiplication, but only 21 percent answered 75 percent or more of the pre-test questions correctly when asked to multiply numbers between 6 and 10 while 59 percent answered fewer than 56 percent of the questions correctly. Few students were able to multiply two-digit numbers successfully.

Magic Fingers: Improving Multiplication Skills at SD Bendungan I

In order to improve students multiplication skills the research team decided to introduce a technique known as "Magic Fingers." In this technique students use their fingers to calculate the answers to multiplication problems, thereby getting around the school's lack of instructional media and, hopefully, giving students the impression that mathematics is fun and easy. Students were divided into groups, and each group was trained to use their fingers to multiply the numbers from six to ten. The groups were allowed to practice together in groups until they felt that they had mastered the technique. The teacher and the members of the research team then organized a competition among the groups with a reward going to the team that most quickly answered the most multiplication problems. The class was excited, and all students seemed engaged and enthusiastic about learning to multiply with their fingers. A post-test was administered later to see whether students' multiplication skills had improved.

The results of the post-test showed different effects of the Magic Fingers intervention on students depending on their prior level of skill in multiplication. For instance, the Magic Fingers technique made no difference in the scores of the 11 percent of students who seemed to have no problems with multiplication on the pre-test. However, the large majority of students scoring in the middle range of the pre-test showed gains in their multiplication scores after learning to use the Magic Fingers technique. Both of these groups mastered the technique relatively quickly. Those students scoring lowest on the pre-test, approximately 30 percent

of those tested, showed no significant improvement in their multiplication skills as a result of the Magic Fingers technique. These students also required a significantly longer time to learn the technique.

Conclusions

The students of SD Bendungan I frequently complained that they found mathematics difficult. Parents reported their concerns that they could not help their children who were struggling in math. And teachers expressed their frustration at the difficulties they faced in helping students to understand mathematics. Clearly, mathematics achievement, and the use of active learning strategies to improve mathematics achievement, was a problem at SD Bendungan I. Teachers know that students have a variety of intelligences and talents that should be drawn upon to make mathematics instruction more active, joyful and effective. They feel they have been more successful teaching for active learning in other subjects, especially science where instructional media are easier to find or develop. But teachers have only been successful with teaching for active learning in the lower grades. Teaching for active learning in the higher grades is still problematic.

We found that conventional techniques for teaching multiplication skills in Grade 5 were unsuccessful for the majority of students. The Magic Fingers technique, however, proved to be a more successful strategy to teach the multiplication of numbers between six and ten as well as two-digit numbers for a majority (59 percent) of the students in this Grade 5 class. We conclude from this that applying the principles of active learning can improve teaching and learning in mathematics instruction at SD Bendungan I.

Finally, the pattern of successes and challenges experienced by teachers at SD Bendungan I in teaching for active learning suggest a problem that should be addressed in future training: Teachers appear to have difficulty transferring what they have learned in the context of one subject to other subjects. These teachers had received explicit training in active learning strategies for science, English, and social studies, areas where teachers either demonstrated or reported their relative comfort in teaching for active learning. Interestingly, the students we interviewed also expressed their preference for these subjects over mathematics, a subject in which their teachers had not received active learning training. While there is no doubt more to the students' difficulties in mathematics than the presence or absence of active learning strategies, their response to the Magic Fingers technique suggests that such strategies can help. And while our introduction of the Magic Fingers technique to this teacher will help her in teaching these particular lessons to future students, it does not address the

problem of teachers transferring learning from one setting or subject matter to another. That remains a topic for future research.

Note

1. Educational Unit Level Curriculum (KTSP: *Kurikulum Tingkat Satuan Pendidikan*) is a basic curriculum framework derived from the national curriculum for K-12 for the purpose of providing guidance in the formulation of educational unit level curriculum and syllabus to each educational unit.

References

- Aubusson, Peter, Robyn Ewing, and Garry Hoban. 2009. *Action Learning in Schools: Reframing Teachers' Professional Learning and Development*. New York: Routledge.
- Bjork, Christopher. 2003. "Local Responses to Decentralization Policy in Indonesia." *Comparative Education Review* 47 (2): 184-216.
- Bolhuis, Sanneke, and Marinus Voeten. 2001. "Toward Self-Directed Learning in Secondary Schools: What Do Teachers Do?" *Teaching and Teacher Education* 17 (7): 837-855.
- Bonwell, Charles C., and James A. Eison. 1991. *Active Learning: Creating Excitement in the Classroom, ASHE-ERIC Higher Education Report Number 1*. Washington, DC: ERIC Digest.
- de Baessa, Yetilú, Ray Chesterfield, and Tanya Ramos. 2002. "Active Learning and Democratic Behavior in Guatemalan Rural Primary Schools." *Compare: A Journal of Comparative and International Education* 32 (2): 205-218.
- Dewey, John. 1900. *The School and Society & The Child and the Curriculum*. Chicago: University of Chicago Press.
- Farrell, Joseph, and Obed Mfum-Memshah. 2002. "A Preliminary Analytical Framework for Comparative Analysis of Alternative Primary Education Programs in Developing Nations." Paper presented at the Comparative and International Education Society Annual Conference, Orlando, FL, March 2002.
- Firlik, Russell. 2000. "A Need for Active Learning: A Cross-Cultural Perspective." *Curriculum and Staff Development* 8 (1): 1-8.
- Freire, Paulo. 1970/2001. *Pedagogy of the Oppressed*. New York: Continuum.
- Herrera, Linda. 2008. "Education and Empire: Democratic Reform in the Arab World?" *International Journal of Educational Reform* 17 (4): 355-373.
- House, J. Daniel. 2008. "Effects of Classroom Instructional Strategies and Self-Beliefs on Science Achievement of Elementary Schools Students in Japan: Results from the TIMSS 2003 Assessment." *Education* 129 (2): 259-266.
- Keyser, Marcia. 2000. "Active Learning and Cooperative Learning: Understanding the Difference and Using Both Styles Effectively." *Research Strategies* 17 (1): 35-44.
- Kimonen, Eija, and Raimo Nevalainen. 2005. "Active Learning in the Process of Educational Change." *Teaching and Teacher Education* 21 (6): 623-635.
- Miles, Matthew, and A. Michael Huberman. 1994. *Qualitative Data Analysis*. Thousand Oaks, CA: SAGE Publications.
- Niemi, Hannele. 2002. "Active Learning—A Cultural Change Needed in Teacher Education and Schools." *Teaching and Teacher Education* 18 (7): 763-780.
- Organisation for Economic Co-operation and Development (OECD). 2009. *Creating Effective Teaching and Learning Environments: First Results from TALIS*. Paris: OECD.
- Olgun, Özlem Sila. 2009. "Engaging Elementary Preservice Teachers with Active Learning Teaching Methodologies." *The Teacher Educator* 44 (2): 113-125.
- Prince, Michael. 2004. "Does Active Learning Work? A Review of the Research." *Journal of Engineering Education* 93 (3): 1-9.
- Rousseau, Jean-Jacques. 1762/1979. *Emile*. New York: Basic Books.
- Rusk, Robert, and James Scotland. 1979. *Doctrines of the Great Educators*. New York: St. Martin's Press.
- Simons, P. R. J. 1997. "Definitions and Theories of Active Learning." In *Active Learning for Students and Teachers: Reports from Eight Countries*, ed. David Stern and Günter Huber (pp. 19-39). New York: Peter Lang.
- Stern, David, and Günter Huber, eds. 1997. *Active Learning for Students and Teachers: Reports from Eight Countries*. New York: Peter Lang.
- Stringer, Ernest. 2007. *Action Research*. 3rd ed. Thousand Oaks, CA: SAGE Publications.
- Sturtevant, Elizabeth, and Wayne Linek. 2007. "Secondary Literacy Coaching: A Macedonian Perspective." *Journal of Adolescent and Adult Literacy* 51 (3): 240-250.
- Vygotsky, Lev S. 1978. *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.
- Woolman, David. 2002. "Lost Educational Opportunity: Can the First and Third Worlds Inform Each Other and Transfer Solutions?" Paper presented at the Comparative and International Society Annual Meeting, Orlando, FL, 6-9 March 2002.