DEVELOPMENT OF SCIENTIFIC PBL LEARNING *SCAFFOLDING* TECHNIQUES IN IMPROVING *CRITICAL THINKING ABILITY* IN CLASS IV GEOMETRY MATERIAL

Tri Widyaningsih [1], Wardono[2], Suratinah[3]
e-mail : triwidyaningsih16@guru.id.belajar.id,
wardono@mail.unnes.ac.id,
etin@ecampus.ut.ac.id,
Program Studi Magister Pendidikan Dasar
Universitas Terbuka Semarang

Abstract

Tri Widyaningsih 2023. Development of Scientific *PBL* Learning *Scaffolding* Techniques in Improving *Critical Thinking Ability* in Class IV Geometry Material. Mathematics learning is very interesting to be associated with character education because mathematics is a universal science that underlies modern development, has an important role in various scientific disciplines and advances human thinking. Geometry material is one of the materials in mathematics that discusses planes and geometric shapes, namely mentioning characteristics and making geometric geometric nets.

Based on the results of interviews with fifth grade students, fourth grade math teachers and observations at SDN Bandungrojo, Ngawen District, Blora Regency, when in class, the ability to think critically on the theme of geometry, seen from the student learning outcomes, was not satisfactory. In addition, they are also less critical in responding to problems related to the material. Improving *critical thinking* abilities and skills needs to be supported by the development of contextual learning.

The population in this study were fourth grade students at SDN Bandungrojo. Sampling was carried out by purposive sampling technique, namely the technique of determining the sample with certain considerations.

Based on the results of the research and discussion, the development of learning tools using the *scaffolding* technique in mathematics learning with geometry material in the natural laboratory produces effective learning tools in improving *critical thinking* skills and the character of loving the environment in class IV. Evidenced by the completeness of students' thinking skills of more than 75%.

Keywords: Scaffolding, Critical Thinking

1. Introductions

Mathematics is a universal science that underlies modern development, has an important role in various scientific disciplines and advances human thought. Mastering and creating technology in the future requires a strong mastery of mathematics from an early age, so that they are able to utilize their knowledge in the life of the nation and state. It is not enough just to provide cognitive mastery, but it is necessary to build the character of students. The mathematics that students learn at school includes algebra, geometry, trigonometry, and arithmetic. In studying mathematics material students often find it difficult. Baxter & William (2010) stated that the teacher dominates the conversation and interaction in the classroom, the explanation of material which only refers to the completeness of the curriculum makes students experience difficulties when solving math problems. Not all difficulties in learning mathematics are considered errors, but difficulties in solving math problems may contain errors in learning mathematics.

Mathematics is formed as a result of human thought related to ideas, processes, and reasoning. Therefore, mathematics subjects need to be given to all students as a basis for improving the ability to think logically, analytically, systematically, critically and the ability to work together (Depdiknas, 2006). Children can distinguish good from bad, even children can take action from existing problems and become provisions in their future life (Ministry of National Education, 2010).

Based on the previous research results in class IV SDN Bandungrojo, Ngawen District, Blora Regency, students were still less active in learning activities, especially in teaching mathematics material geometry.

Scaffolding techniques can be used by teachers to get closer to students, so that teachers know and understand the shortcomings of students in their class. Implementation of learning with the *scaffolding* technique in addition to receiving guidance and support from the teacher, students can obtain information, carry out discussion activities and exchange ideas with other students through group learning settings.

This fact requires the teacher's attention and guidance to develop learning tools that are valid, practical and effective (Nieveen, 1999). a group or independently in a natural laboratory. Regarding this research, it is supported by relevant previous researchers, conducted by Prihastari in 2018 who applied the *scaffolding* technique in learning mathematics in natural schools, stating that, the results of an analysis of the effectiveness of learning *scaffolding* techniques in the natural laboratory on geometry class IV, namely: The value of *critical thinking* skills experimental class students achieved the specified completeness criteria, namely the proportion of students who scored more

than KKM = 75, which is more than 75%. The influence of the character of loving the environment and students' *critical thinking* skills during the learning process on *critical thinking* skills is 74.2%.

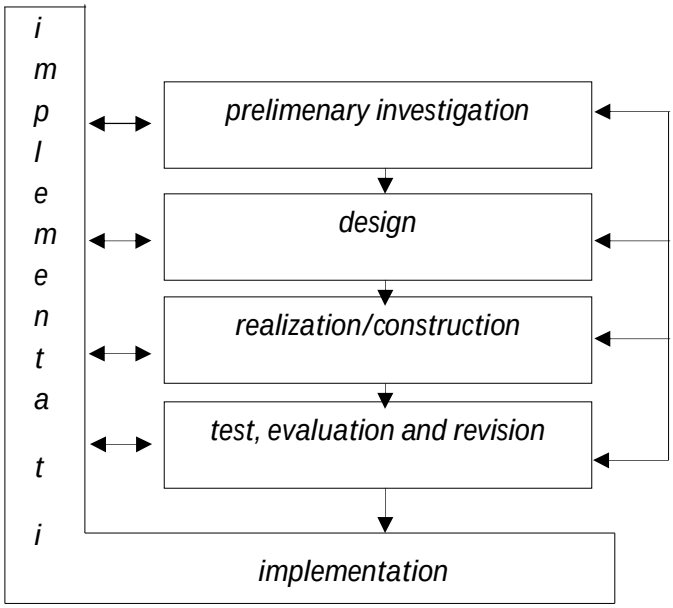
2. Research Methods

Researchers use a research approach that is a

quantitative approach. According to Sugiyono (2015) quantitative research techniques are based on the philosophy of positivism which is used to research certain samples or populations. In general, the sampling technique is carried out randomly, so that the research conclusions can be generalized to the population where the sample was taken. The required data was collected using research instruments and the data analysis used was qualitative in nature which aims to test the hypotheses that have been applied. This research produces data in the form of numbers and is analyzed using statistics. Researchers who follow the positivistic flow develop knowledge by accumulating the data that has been obtained in the form of numbers based on actions that can be seen from the sample. The data obtained is then processed by analysis in the form of a questionnaire. (Setyosari, 2015). Lestari and Yudhanegara (2017) explain that quantitative research can be carried out by conducting research on the relationship between variables to test a theory so that quantitative data can be obtained which can then be analyzed statistically. Sukmadinata (2017) also revealed that the quantitative research method is a research method based on numbers, statistical processing, structures and controlled experiments.

This study uses a mixed method research method, combining quantitative and qualitative. Creswell & Plano Clark (in Creswell, 2012) defines a mixed method research design as a procedure for collecting, analyzing, and mixing both quantitative and qualitative methods in one study or series of studies to understand the research problem. The basic assumption of using both quantitative and qualitative methods in combination, provides a better understanding of the problems and research questions than either method alone (Creswell, 2012).

This research was conducted at SDN Bandungrojo, Ngawen District, Blora Regency. The research was conducted on fourth grade elementary school students The design flowchart for the development of learning tools using the *scaffolding* technique uses the Plomp model (Plomp, 2007), as follows:



3. Result and Analysis

After obtaining initial data in the field, researchers and teachers grouped students based on ability levels (low, medium, high) and obtained five heterogeneous groups, each consisting of 4-5 students. This group will be applied during research in the experimental class. In January to May the researcher completes proposals, consults, compiles tools to be validated, requests validation from experts and colleagues, and revises tools so that valid tools are obtained that are in accordance with theory and needs in the field. In early May, researchers conducted research to test practical tools and test *critical thinking* skills. At the end of May the researcher used valid and practical tools in the experimental class, besides that the researcher conducted documentation and interviews to obtain quantitative and qualitative data in the field.

As explained in the research objective, namely to produce a mathematics learning tool for *scaffolding* techniques in a natural laboratory on geometry material in class IV that is valid, practical, and effective in class.

The results of the research in this section are the stages of developing mathematics learning tools and data analysis using the *scaffolding* technique in the natural laboratory on geometry material referring to the educational development model from Plomp. In this study the learning

tools developed included syllabus, lesson plans, student books, tests of *critical thinking* skills, character observation sheets for loving the environment and *critical thinking* skills, implementation of lesson plans, peer responses, and student responses.

Based on the results of observations, there are several problems including the teacher still relying on existing learning tools so that they do not motivate students to share knowledge between students with one another. Another problem is that the school does not yet have an observation sheet on the character of loving the environment and written *critical thinking* skills as a form of assessment. The teacher gives an assessment only based on overall observation at the end of the semester, so that the increase or decrease in these variables is biased.

Based on the results of the study above, the researcher views that the development of tools is very necessary in the implementation of the natural school curriculum, so that learning objectives can be achieved.

4. Closing

The development of learning tools using the *scaffolding* technique in learning mathematics with geometry material in the natural laboratory produces valid learning tools in improving *critical thinking* skills and the character of loving the environment in class IV. Evidenced by the results of the validation of learning tools by the validator which produces an average score with very good criteria and the *critical thinking ability* test used has met validity, reliability, balanced difficulty level, and sufficient minimal discriminating power.

The development of learning tools using the *scaffolding* technique in mathematics learning with geometry material in the natural laboratory produces learning tools that are practical in improving *critical thinking* skills and the character of loving the environment in class IV. Evidenced by the average score of analysis of lesson plans implementation data with good criteria and the average score of peer response data analysis with very good criteria and students giving positive and good responses to learning using *scaffolding* techniques in natural laboratories on geometry material.

The development of learning tools using *scaffolding* techniques in mathematics learning with geometry material in the natural laboratory produces learning tools that are effective in improving *critical thinking* skills and the character of loving the environment in class IV. Evidenced by the completeness of students' thinking skills of more than 75%.

Simultaneously the character of loving the environment and *critical thinking* skills can explain

students' *critical thinking* skills by 38.5%. But partially what can explain students' *critical thinking* skills is the variable *critical thinking* skills, while the character of loving the environment cannot explain students' *critical thinking* skills.

In the process of learning mathematics on geometry material, teachers should use the *scaffolding* technique as an alternative learning device at school

Bibliography

Achor, E, *et.al. 2009.* "Effect of ethnomathematics teaching approach on senior secondary students' achievement and retention in locus". *Educational Research and Review*. Voumel. 4 (8), 385-390.

Arikunto, S. 2009. *Dasar-dasar Evaluasi Pendidikan.* Jakarta: Bumi Aksara.

Arikunto, S. 2010. *Prosedur Suatu Pendekatan dan Praktek.* Jakarta: Rineka Cipta.

Azhar Arsyad. 2013. *Media Pembelajaran.* Jakarta: Rajagrafindo Persada

B.E.D Teacher Trainees. *An International Journal of Education*. Volume 4(2):76-85

Begg, A & Hamilton. 2001. "Ethnomathematics: Why, and What Else?". *ZDM* . Volume 33(3), 71-74.

Bush, W. S. 2005. "Improving Research on Mathematics Learning and Teaching in Rural Contexts". *Journal of Research in Rural Education*. Volume 20(8), 1-11.

Chalil, A, *et al.* 2008. *Pembelajaran Bermuatan Fitrah.* Jakarta: Balai Pustaka.

Daryanto. 2016. Media Pembelajaran. Yogyakarta: Gava Media

D'Ambrosio, U. 2006. "The Program Ethnomathematics and the Challenges of Globalization". *International Journal for the History of Science*. Volume 1(8), 74-82.

Hake, R. R. 1999. Analyzing Change/Gain Scores. USA: Dept. of Physics, Indiana University.

Hamel. 2011. "Meningkatkan Kemampuan Penjumlahan Melalui Pendekatan Keterampilan Proses Bagi Anak Tunagrahita Ringan Di Kelas Dasar Iv/C". *Jurnal Ilmiah Pendidikan Khusus*. Volume 1(2), 140-150.

Hartoyo, A. 2012. "Eksplorasi Etnomatematika pada Budaya Masyarakat Dayak Perbatasan Indonesia-Malaysia Kabupaten Sanggau Kalbar" *Jurnal Penelitian Pendidikan.* Volume 13 (1), 14-23.

Jihad, A. & Haris, A.2009. *Evaluasi Pembelajaran.* Yogyakarta: Multi Pressindo.

Kemendikbud. 2010. *Pengembangan Pendidikan Budaya dan Karakter Bangsa*. Jakarta: Kemendikbud.

Kurumeh, M. S, *et al.* 2012. "Improving Students' Retention in Junior Secondary School Statistics using the Ethno-mathematics Teaching Approach in Obi and Oju Local Government Areas of Benue State, Nigeria". *Greener Journal of Educational Research*. 2(3), 54-62.

Litbang Kemdikbud. 2011. *Survei Internasional Pisa(Program for Internasional Student Assessment).* http://litbang.kemdikbud.go.id/index.php/survei-internasional-pisa (diunduh 22 September 2013).

Mandur, K, *et al*. 2013. "Kontribusi Kemampuan Koneksi, Kemampuan Representasi, dan Disposisi Matematis Terhadap Prestasi Belajar Matematika Siswa SMA Swasta Di Kabupaten Manggarai". *e-Journal Program Pascasarjana Universitas Pendidikan Ganesha.* Volume 2, 1-10.

Multiple Regression: Statistical Methods Using IBM SPSS. *www.sagepub.com /upm-data/49300_ch_7v.pdf (*Diunduh 21 Juni 2014).

Mweene, V. C *et al.* 2012. "How Pre-service Teachers'Understand and Perform Science Process Skills". *Eurasia Journal of Mathematics, Science & Technology Education.* Volume 8(3), 167-176.

NCATE/NCTM. 2003. *Programs for Initial Preparation of Mathematics Teachers*. http://www.math.uri.edu/~eaton/NCATENCTM.pdf (diunduh 20 September 2013).

NCTM. 2000. *Executive Summary Principles and Standards for School Mathematics.* http://www.nctm.org/uploadedFiles/Math_Standards/12752_exec_pssm.pdf (diunduh 20 September 2013).

Ontario. 2005. *The Ontario Curriculum Mathematics*. http://www.edu.gov. on.ca/eng/ curriculum/elementary/math18curr.pdf (diunduh 25 Desember 2013).

Permendikbud Nomor 21 Tahun 2016 tentang Standar Isi.

Permendikbud Nomor 22 Tahun 2016 tentang Standar Proses Pembelajaran.

Permendikbud Nomor 37 Tahun 2018 tentang Kompetensi Dasar dan Kompetensi Inti.

Permendiknas, No. 22 tahun 2006 tentang standar isi

Poerwanti Endang dkk. *Asesmen Pembelajran SD.* Jakarta: Direktorat Jendral Pendidikan Tinggi Departemen Pendidikan Nasional.

Purwanto. 2010. *Evaluasi Hasil Belajar*. Yogyakarta: Pustaka Pelajar

Prince, M & Felder, R. 2007."The Many Faces of Inductive Teaching and Learning*"*. *Journal of College Science Teaching.* Volume 36 (5), 15-20.

Rachmawati, I. 2012. "Eksplorasi Etnomatematika Masyarakat Sidoarjo*"*. Surabaya: Universitas Negeri Surabaya.

Rauscher, W. 2012. "How project-based learning manifests itself in technology education Textbooks". *African Journal of Research in MST Education*. Volume 16 (1), 18–31.

Rifa'i, Achmad., & Anni, C.T. 2012. *Psikologi Pendidikan*. Semarang: Unnes Pres.

Rifa'i, Achmad., & Anni, C.T. 2016. *Psikologi Pendidikan*. Semarang: Unnes Pres.

Rochmad, 2012. "Desain Model Pengembangan Media pembelajaran Matematika" *Jurnal Kreano*, Volume 3 (1), 59-72.

Rohendi, D & Jojon. 2013. "Connected Mathematics Project (CMP) Model Based on Presentation Media to the Mathematical Connection Ability of Junior High School Student". *Journal of Education and Practice*. Volume 4(4), 17-22.

Rohendi, D. 2012. "Developing E-Learning Based on Animation Content for Improving Mathematical Connection Abilities in High School Students". *International Journal of Computer Science Issues*. Volume 9(1), 1-5.

Shockey, T & Bear, J. 2006. "An ethnomathematics approach toward understanding a Penobscot hemispherical lodge". *Horizontes*. Volume 24(1). 69-76.

Siany, L & Catur, A. 2009. *Khasanah Antropologi*. Jakarta: Wangsa Jatra Lestari.

Slavin, R. E. 2011. *Psikologi Pendidikan, Teori dan Praktik.* Jakarta: Indeks.

Sri Anitah (2012). *Strategi Pembelajaran di SD.* Banten: Universitas Terbuka

Sugiyono. 2015. *Metode Penelitian dan Pengembangan.* Bandung: Alfabeta

Sugiyono. 2015. *Metode Penelitian Pendidikan*. Bandung: Alfabeta.

Sumiati dan Arsa(2009). *Metode pembelajaran.*Bandung:CV Wacana Prima

Suryanto Adi dkk. 2014. *Evaluasi Pembelajaran di SD.* Banten : Universitas Terbuka

Sugiyono. 2011. *Statistik untuk Penelitian*. Bandung : Alfabeta.

Sugiyono. 2012. *Metode Penelitian Pendidikan Pendeketan Kuantitatif, Kualitatif, dan R & D).* Bandung: Alfabeta.

Suherman, E, *et al.* 2003. *Strategi Pembelajaran Matematika Kontemporer*. Bandung : UPI.

Sukestiyarno,Y. L. 2012a. *Statistika Dasar.* Semarang: Universitas Negeri Semarang.

Sukestiyarno,Y. L. 2012b. *Olah Data Penelitian Berbantuan SPSS.* Semarang: Universitas Negeri Semarang.

Syah, M. 2011. *Psikologi Belajar*. Jakarta : Raja Grafindo Persada.

Taufik Agus dkk,2011. *Pendidikan Ana di SD*, Jakarta: Universitas Terbuka.
Sudijono, A. 2007. *Pengantar Evaluasi Pendidikan.*Jakarta: PT Raja Grafindo Persada.

Thomas, J. 2000. *A Review Of Research On Project-Based Learning.*

Tim Pengembang Ilmu Pendidikan FIP-UPI. 2007. *Ilmu dan Aplikasi Pendidikan.* Bandung: Imtima.

Trianto. 2012. *Mendesain Model Pembelajaran Inovatif-Progresif*. Jakarta: Kencana.

Usman, M. 2006. *Menjadi Guru Profesional.* Bandung: PT Remaja Rosdakarya.

Warsono & Hariyanto. 2012. *Pembelajaran Aktif Teori dan Asesmen.* Bandung: Rosda.

Wibowo, A. 2012. *Pendidikan Karakter*. Yogyakarta: Pustaka Pelajar.

Widayanto. 2006. "Pengembangan Keterampilan Proses Dan Pemahaman Siswa Kelas X Melalui Kit Optik". *Jurnal Pendidikan Fisika Indonesia*. Volume 5(2), 1-7.

Yılmaz & Nihal. 2013. "An Investigation of the Effect of Project-Based Learning Approach on Children's Achievement and Attitude in Science". *The Online Journal of Science and Technology*. Volume 3(2), 9-17.

Yunus, R. 2013. "Transformasi Nilai-Nilai Budaya Lokal sebagai Upaya Pembangunan Karakter Bangsa" *Jurnal Penelitian Pendidikan.* Volume 14(1), 65-77.

Yusoff. 2006. *Project-Based Learning Handbook*. Kuala Lumpur: Communications And Training Sector.