HUBUNGAN KEMAMPUAN BERPIKIR LOGIS DENGAN KETERAMPILAN PROSES SAINS DASAR SISWA SD KELAS V SE-KOTA MATARAM

JURNAL SKRIPSI

Oleh

Duwi Bagus Sriyansyah
NIM E1E214024

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UNIVERSITAS MATARAM
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN
Jl. Majapahit 62 Mataram NTB 83125 Telp. (0370) 623873

HALAMAN PENGESAHAN JURNAL SKRIPSI

Skripsi Berjudul : Hubungan Kemampuan Berpikir Logis dengan Keterampilan Proses Sains Dasar Siswa SD Kelas V Se-Kota Mataram.

Yang Disusun Oleh:

Nama : Duwi Bagus Sriyansyah
Nim : E1E214024
Prog. Studi : Pendidikan Guru Sekolah Dasar

Telah diperiksa dan disetujui

Menyetujui,

Mataram, 10 Juli 2018

Dosen Pembimbing Skripsi I,	Dosen Pembimbing Skripsi II,
(Dr. Hj. Darmiany, M.Pd)	(H. M. Liwa Ilhamdi, S. P.d., M.Si)
NIP. 195812181986032002	NIP. 19700810 199512 1 001

Menyetujui
Ketua Jurusan Ilmu Pendidikan

(Drs. Safruddin, M.Pd)
NIP. 195710031985031002

Hubungan Kemampuan Berpikir Logis dengan Keterampilan Proses Sains Dasar Siswa SD Kelas V Se-Kota Mataram

D B Sriyansyah[1]

[1]Pendidikan Guru Sekolah Dasar, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Mataram, Jl. Majapahit No. 62, Mataram 83115

Email: duwibagussriyansyah@gmail.com

Abstract. Studi sebelumnya telah mengungkapkan bahwa pengajaran keterampilan proses sains dapat mempengaruhi kemampuan berpikir logis. Namun, masih sedikit penelitian yang terkait hubungan antara kemampuan berpikir logis dengan keterampilan proses sains pada Sekolah dasar. Di sini, studi korelasional dilakukan untuk menguji sampai sejauh mana kemampuan berpikir logis dan keterampilan proses sains dasar siswa Sekolah dasar dan menentukan hubungan antara kedua variabel tersebut. Tes Berpikir Logis (BL) dan Tes Keterampilan Proses Sains Dasar (KPSD) diberikan kepada 227 siswa kelas lima Sekolah dasar di Mataram, yang ditentukan dengan menggunakan teknik stratified cluster random sampling. Korelasi antara variabel dianalisis dengan menggunakan Spearman Rank karena data tidak terdistribusi normal. Hasil penelitian menunjukkan korelasi yang lemah, tetapi signifikan antara kedua variabel sebesar (r = 0,124). Hanya 7% siswa masuk dalam tahap penalaran operasional formal, 59% operasional konkrit, dan 34% tahap transisi. Adapun dalam keterampilan proses sains dasar, siswa menunjukkan kinerja terendah dalam keterampilan memprediksi dan kinerja tertinggi dalam keterampilan mengklasifikasi. Studi ini memberikan informasi yang berguna untuk mengembangkan metode pembelajaran yang tepat mengatasi masalah pedagogis dalam mengajar siswa berpikir logis dan menggunakan keterampilan proses sains di Sekolah dasar.

1. Pendahuluan

Kemampuan berpikir logis telah menjadi tujuan utama penelitian dalam pendidikan sains selama bertahun-tahun. Dalam literatur, ada banyak istilah berpikir logis, seperti "kemampuan penalaran formal" [1-6], "pemikiran logis" [7-9], "kemampuan berpikir formal" [10], dan "penalaran ilmiah"[11-14]. Baru-baru ini, penelitian dalam pengembangan kemampuan penalaran di antara siswa mengungkapkan bahwa keterampilan penalaran pra-instruksi siswa mungkin terkait dengan fasilitas mereka dalam memperoleh konsep ilmiah [12,14,15], dan ini dapat digunakan untuk mengukur efektivitas strategi pembelajaran [12 -13].

Ada sejumlah penelitian tentang upaya yang berhasil untuk memberikan bukti bahwa pemikiran logis siswa dapat dikembangkan melalui pelatihan khusus dan juga dapat ditransfer [16,17]. Dalam beberapa tahun terakhir, peneliti pendidikan sains masih fokus pada pertanyaan - bagaimana mengajar siswa untuk berpikir logis dengan menggunakan pembelajaran yang lebih efektif, dan dalam keadaan apa seorang siswa dapat diajarkan untuk menggunakan pemikiran logis. Padilla [18] berpendapat bahwa kemampuan berpikir logis mungkin terkait dengan keterampilan proses sains. Alasannya adalah

bahwa pemikiran logis dan keterampilan proses sains terlibat dalam melakukan eksperimen, penyelidikan, evaluasi bukti, penyimpulan, dan argumentasi yang mendukung pembentukan dan modifikasi konsep ilmiah [18,19].

Kemampuan berpikir logis meliputi kemampuan untuk mengidentifikasi dan mengendalikan variabel dan menggunakan logika kombinatorial, korelasional, probabilistik dan proporsional [7]. Sedangkan keterampilan proses sains dibagi menjadi dua jenis yaitu keterampilan proses sains dasar dan terpadu oleh Science – A Process Approach (SAPA). Keterampilan proses sains dasar termasuk kemampuan yang digunakan saat mengamati, mengklasifikasikan, berkomunikasi, mengukur, menyimpulkan, dan memprediksi [20]. Keterampilan proses dasar yang biasanya diajarkan di tingkat dasar, bertindak sebagai prasyarat dan landasan untuk belajar proses sains terpadu yang biasanya diajarkan di Sekolah menengah. Keterampilan proses sains terpadu termasuk mengendalikan variabel, menafsirkan data, merumuskan hipotesis, mendefinisikan secara operasional, dan bereksperimen [20].

Hubungan yang jelas antara kemampuan berpikir logis dan keterampilan proses dapat dilihat ketika mengidentifikasi dan kontrol variabel, dan berhipotesis. Siswa yang tidak dapat mengidentifikasi dan mengontrol variabel akan mengalami kesulitan dalam merumuskan hipotesis, menafsirkan data dan membangun generalisasi. Secara umum, keterbatasan kognitif dapat mencegah siswa belajar keterampilan proses sains. Di sisi lain, strategi pembelajaran yang menekankan keterampilan proses sains dapat melatih kemampuan berpikir logis [4]. Meskipun hubungan kausal antara kedua variabel tersebut masih belum pasti, sejumlah studi menyimpulkan bahwa pengajaran keterampilan proses dapat mempengaruhi kemampuan berpikir logis [3].

Sejumlah penelitian telah mengkonfirmasi korelasi tinggi antara kemampuan berpikir logis dan keterampilan proses sains [3,4,7,8,10]. Namun, semua penelitian tersebut menggunakan sampel siswa menengah dan meneliti keterampilan proses sains terpadu. Sementara penelitian yang menyelidiki hubungan antara pemikiran logis dan keterampilan proses dasar di Sekolah dasar masih terbatas. Hal ini telah mendorong peneliti untuk menyelidiki lebih jauh hubungan antara dua kemampuan siswa Sekolah dasar. Oleh karena itu, tujuan dari penelitian ini adalah untuk menguji kemampuan berpikir logis dan keterampilan proses sains dasar dan untuk melihat temuan dari penelitian sebelumnya apakah berlaku juga untuk siswa Sekolah dasar.

2. Metode

Sebuah studi korelasional dengan teknik stratified cluster random sampling digunakan untuk memilih 227 siswa di kelas 5 dari tujuh Sekolah Dasar Negeri di Mataram sebagai sampel dalam penelitian ini. Tujuh Sekolah dipilih dengan mempertimbangkan peringkat mereka (atas, menengah dan bawah) berdasarkan skor rata-rata Ujian Nasional 2017. Peserta menyelesaikan dua tes (BL dan KPSD) yang diawasi oleh wali kelas dan penulis selama dua hari berturut-turut pada akhir semester dua (tahun ajaran 2017/2018). Usia siswa berkisar dari 10 tahun hingga 13 tahun. Siswa yang berpartisipasi dalam penelitian ini belum menjalani pelatihan khusus baik pada kemampuan berpikir logis atau keterampilan proses sains dasar. Tes standar digunakan dalam penelitian karena dianggap valid untuk mengumpulkan data dan menghasilkan tingkat hubungan yang tinggi antara skor kedua tes, sehingga memberikan bukti korespondensi yang kuat antara kemampuan.

2.1. Instrumen

Kemampuan berpikir logis siswa didokumentasikan dengan respon format pilihan ganda dan isian [7]. Tes berpikir logis (BL) terdiri dari sepuluh item yang memberikan ukuran penalaran formal pada lima pola penalaran: logika proporsional, variabel pengendali, logika kombinatorial, logika probabilistik, dan logika korelasional. Setiap pola penalaran diwakili oleh dua item soal dengan total nilai 10. Siswa akan mendapatkan nilai 1 jika mereka memberikan jawaban dan alasan dengan benar. Sementara untuk dua item penalaran kombinatorial terakhir, siswa harus menyediakan semua kombinasi yang mungkin dari beberapa variabel. Tes ini mirip dengan yang dikembangkan oleh Lawson [1] dan itu dipilih karena validitas dan hasil reliabilitas pada sampel siswa mulai dari kelas enam dan dapat

meminimalkan efek menebak [7,21]. Tes membutuhkan waktu 40 menit untuk menyelesaikannya. Contoh dari bentuk item probabilistik BL ditunjukkan pada Gambar.1.

BIBIT SAYURAN

Soal 5.1
Seorang tukang kebun membeli kotak yang berisi 3 bibit labu dan 3 bibit kacang.
Apabila hanya satu bibit yang diambil dari kotak secara acak, berapa besar kesempatan bibit yang terambil adalah bibit kacang?

A. 1 dari 2
B. 1 dari 3
C. 1 dari 4
D. 1 dari 6
E. 4 dari 6

Soal 5.2
Manakah dari pilihan berikut yang merupakan alasan jawabanmu?

A. Butuh empat kali pengambilan karena tiga bibit labu bisa saja diambil secara berurutan.
B. Satu bibit kacang mesti diambil dari total enam bibit yang tersedia.
C. Satu bibit kacang perlu diambil dari tiga bibit kacang yang tersedia.
D. Setengah dari banyak bibit yang tersedia adalah bibit kacang.
E. Selain satu bibit kacang, tiga bibit labu dapat diambil dari total enam bibit yang tersedia.

Gambar 1. Contoh item penalaran probabilistik pada tes berpikir logis

Keterampilan proses sains dasar diukur dengan format pilihan ganda dengan jumlah 33 item soal. Tes ini meliputi enam aspek keterampilan proses dasar untuk siswa di kelas 4 sampai 8 (usia 8 hingga 14 tahun) mengamati, mengklasifikasikan, berkomunikasi, mengukur, menyimpulkan, dan memprediksi. Pengembangan dan validasi tes sepenuhnya dijelaskan di tempat lain [22]. Konten di dalam tes diambil dari semua bidang ilmu sehingga tes tersebut tidak mendukung latar belakang ilmu tertentu. Tes membutuhkan waktu 50 menit untuk menyelesaikannya. Contoh item soal aspek memprediksi ditunjukkan pada Gambar.2.

23. Randy dan Linda mengerjakan sebuah proyek pada saat pelajaran IPA. Mereka mencatat temperatur air setiap menit. Tabel berikut ini menunjukkan hasil pengamatan mereka.

Waktu	Temperatur
1 menit	18^0C
2 menit	22^0C
3 menit	25^0C
4 menit	29^0C
5 menit	$__^0$C

Bagaimana menurutmu temperatur air <u>setelah lima menit</u>?

A. 26^0C
B. 29^0C
C. 32^0C
D. 35^0C

Gambar 2. Contoh item soal memprediksi pada tes keterampilan proses sains dasar

2.2. Analisis

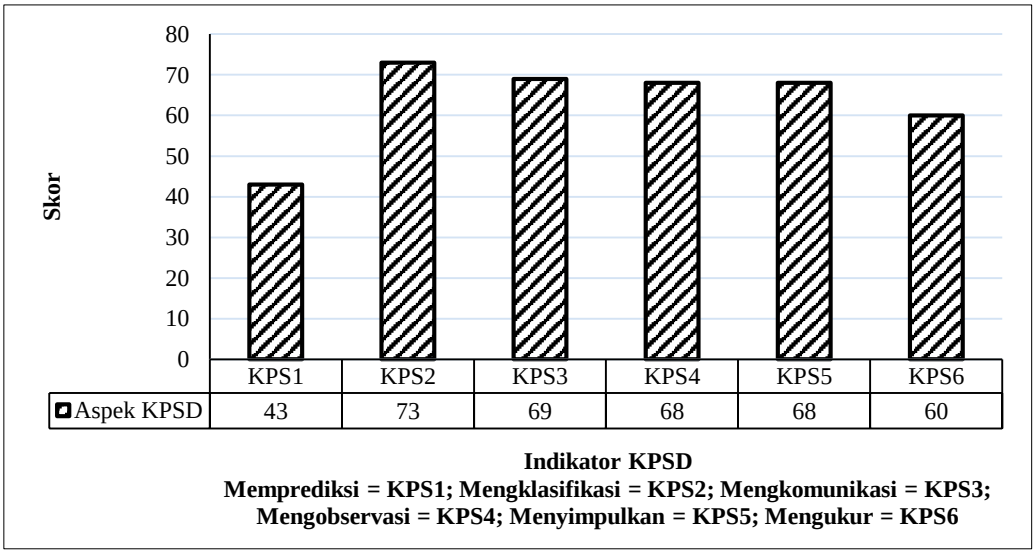
Untuk meningkatkan validitas terjemahan bahasa Indonesia dari tes dan memperoleh teks yang ditulis dalam bahasa yang sesuai, prosedur sama seperti yang digunakan oleh Valanides [5] diadopsi. Selain itu, untuk lebih memperkuat validitas tes dan menyesuaikan tujuan dengan kurikulum sains Indonesia untuk Sekolah dasar, maka validitas isi dinilai oleh pakar pendidikan sains. Kedua item tes (BL dan KPSD) ditinjau oleh dua anggota fakultas ilmu pendidikan di Universitas Mataram. Mereka diberikan tes dan tujuan pembelajaran yang sesuai untuk setiap item tes. Semua ahli setuju dengan sedikit revisi bahwa pertanyaan-pertanyaan dalam kedua tes itu berharga dan sesuai dengan kurikulum sains utama Indonesia.

Skor BL dapat digunakan untuk mengkategorikan siswa berdasarkan tahap berpikirnya yaitu formal, transisi, atau penalaran konkret. Skor tes dari 0-1, 2-3 dan 4-10 digunakan untuk mengklasifikasikan siswa sebagai berpikir konkrit, transisi, dan formal [5,21]. Sementara skor siswa di KPSD tidak digunakan untuk mengklasifikasikan siswa ke dalam kategori tertentu.

Semua data yang terkumpul dianalisis dengan menggunakan statistik deskriptif untuk menemukan skor rata-rata dan persentase siswa di setiap kategori, dan statistik inferensial untuk menentukan korelasi antara variabel yang dinilai. Statistik non-parametrik, khususnya korelasi Spearman Rank digunakan untuk menentukan korelasi antara dua ukuran karena variabel tidak terdistribusi normal.

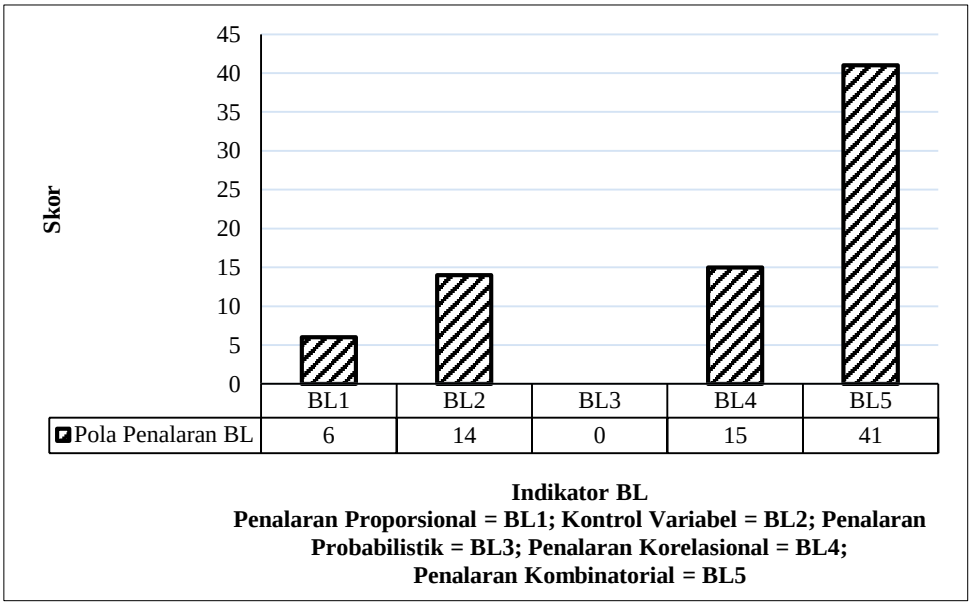
3. Hasil dan Pembahasan

Keterampilan proses sains didefinisikan sebagai seperangkat keterampilan yang digunakan para ilmuwan untuk memecahkan masalah. Keterampilan proses sains dasar dianggap sebagai dasar bagi siswa untuk belajar keterampilan proses yang lebih kompleks [3,20]. Keenam keterampilan proses sains dasar tersebut harus dikuasai oleh siswa sekolah dasar di kelas 4, 5 dan 6. Gambar 3 menunjukkan skor rata-rata untuk total tes dan subtes keterampilan proses dasar. Skor rata-rata KPSD adalah 64 dari 100, dan dengan pengecualian keterampilan memprediksi rata-rata skor subtest KPS menunjukkan prestasi sedang. Siswa menunjukkan kinerja tertinggi dalam keterampilan mengklasifikasi (KPS2), sementara mereka menunjukkan kinerja terendah dalam keterampilan memprediksi. Ini berarti bahwa siswa sulit dalam keterampilan memprediksi dan juga menyiratkan metode pembelajaran yang digunakan untuk mengajar siswa tidak memfasilitasi secara efektif dalam mengajar keterampilan memprediksi. Thiel & George [23] menjelaskan bahwa faktor yang mempengaruhi kemampuan memprediksi siswa adalah pengalaman mereka. Oleh karena itu, perlu dipraktekkan berulang kali di kelas [23,24].



Gambar 3. Rata-rata skor keterampilan proses sains dasar pada setiap aspek.

Berpikir pada umumnya diasumsikan sebagai proses kognitif, aktivitas mental yang digunakan untuk memperoleh pengetahuan. Hasil penelitian menunjukkan bahwa perkembangan kemampuan penalaran siswa kelas 5 di Mataram adalah 59% pada tingkat operasional konkret, 34% pada tingkat transisi dan 7% pada tingkat operasional formal. Gambar 4 menampilkan skor rata-rata untuk total tes BL dan subtes (lima pola penalaran).



Gambar 4. Rata-rata skor pada setiap pola penalaran tes berpikir logis

Siswa yang mendapat nilai 4 dari 10 (40 dari 100) atau lebih tinggi dalam skor BL diberi katagori pemikir formal. Hampir seluruh siswa pada sampel penelitian ini gagal mencapai pemikiran formal. Kinerja terendah di antara subtes pemikiran logis adalah logika probabilistik seperti yang ditunjukkan pada Gambar. 4. Tidak ada siswa yang mampu memecahkan pertanyaan probabilistik sama sekali. Temuan ini sejalan dengan hasil sebelumnya yang dilaporkan oleh Tobin & Capie [25] bahwa logika probabilistik relatif rendah di semua kelas 7-12. Siswa menunjukkan kinerja tertinggi dalam logika kombinatorial. Namun, skor rata-rata total tes BL dan hampir semua subtes pemikiran logis relatif rendah. Ini berarti bahwa siswa membutuhkan ruang untuk pembelajaran tambahan yang secara khusus mengajarkan pemikiran logis berulang kali dan secara eksplisit.

Menilai kemampuan berpikir logis dan keterampilan proses siswa penting dalam proses pembelajaran. Penelitian sebelumnya melaporkan bahwa pengajaran keterampilan proses sains memiliki potensi besar untuk mengajar siswa berpikir secara logis [21,25]. Temuan penelitian menunjukkan hubungan yang lemah antara kemampuan berpikir logis dan keterampilan proses dasar ($r = 0{,}124$), tetapi secara statistik signifikan pada tingkat 0,05. Korelasi ini adalah bukti lebih lanjut dari hubungan antara pemikiran logis dan keterampilan proses dasar. Korelasi yang rendah dapat dijelaskan bahwa sebagian besar siswa yang merupakan pemikir operasional konkret, biasanya mampu mengidentifikasi dan mengendalikan beberapa variabel yang mempengaruhi suatu fenomena tertentu tetapi mereka tidak melakukan keterampilan secara sistematis. Selain itu, seorang pemikir konkret juga mampu memproses informasi tanpa memahami alasannya [26]. Tingkat kinerja dalam pemikiran logis ini menyarankan bahwa para siswa akan merasa lebih sulit jika dibandingkan dengan tingkat kinerja siswa dalam keterampilan proses dasar. Para siswa dalam penelitian ini tidak diberikan pelatihan khusus baik pada keterampilan proses sains atau pada keterampilan berpikir logis. Namun, hasil penelitian menunjukkan bahwa kinerja siswa lebih tinggi dalam keterampilan proses sains daripada keterampilan berpikir. Ini berarti bahwa dalam proses pembelajaran siswa secara tidak langsung mempraktekkan keterampilan proses daripada keterampilan berpikir. Oleh karena itu,

pengajaran keterampilan proses sains harus dirancang secara sistematis dan eksplisit untuk mengajar siswa berpikir logis.

4. Kesimpulan

Tingkat pencapaian keterampilan proses sains dasar siswa Sekolah dasar kelas 5 di Mataram dikategorikan ke dalam pencapaian tinggi. Sementara untuk berpikir logis, mayoritas siswa berada di level operasional konkrit. Kinerja terendah dari BL dan subtest KPS adalah logika probabilistik dan keterampilan memprediksi masing-masing, yang mirip dengan hasil yang dilaporkan dalam studi sebelumnya. Temuan penelitian menunjukkan bahwa ada hubungan yang lemah, tetapi secara statistik signifikan, antara kemampuan berpikir logis dan keterampilan proses sains dasar. Hasilnya juga menguatkan bukti yang dilaporkan dalam studi sebelumnya yang dilakukan di tingkat yang lebih atas dan menguji keterampilan proses sains terpadu. Hubungan antara keterampilan berpikir logis dan keterampilan proses, juga berlaku untuk siswa Sekolah dasar. Namun, hubungan sebab-akibat antara set kemampuan masih perlu diselidiki lebih lanjut dengan menggunakan desain penelitian eksperimental.

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A study of the logical thinking abilities and basic science process skills of the fifth grade students in Mataram

D B Sriyansyah[1]

[1]Department of Primary Teacher Education, Faculty of Teacher Training and Education, University of Mataram, Jl. Majapahit No. 62, Mataram 83115

Email: duwibagussriyansyah@gmail.com

Abstract. The previous studies have revealed that process skill teaching might influence logical thinking ability. There are, however, still few in number the research-based evidences related to the relationship between the two when it was determined in the primary school students. Here, a correlational study was conducted to examine logical thinking abilities and basic science process skill of primary school students and determine the relationship, if any, between these two variables. The Test of Logical Thinking (ToLT) and the Test of Basic Science Process Skills (TBSPS) were administered to 227 fifth grade students of the primary school in Mataram, which was engaged by using the stratified cluster random sampling. The correlation between assessed variables was analyzed by using the Spearman rank correlation because the variables involved are not normally distributed. The findings showed that a weak, but significant correlation between achievement on the two assessed variables ($r = 0.124$). Only 7% students is formal thinker, while respectively 59% concrete thinker, and 34% transitional thinker. As for basic science process skills, students demonstrated the lowest performance on predicting skill and the highest performance on classifying skill. This study provides useful information to develop appropriate learning methods which overcome the pedagogical issues in teaching students to think logically and to use process skills at primary school.

1. Introduction

Logical thinking abilities have become a major goal of research in science education over the years. In the literature, there are many terms of logical thinking, such as "formal reasoning ability" [1-6], "logical thinking" [7-9], "formal thinking ability" [10], and "scientific reasoning" [11-14]. Recently, research into the development of reasoning abilities among students revealed that students' preinstruction reasoning skills might be associated with their facility at acquiring scientific concepts [12,14,15], and it can be used to measure the effectiveness of learning strategies [12-13].

There have been a number of studies of successful attempts to provide evidences that students' logical thinking can be developed through special training and also can be transferred [16,17]. In recent years, science education researchers still focus on the questions–how to teach students to think logically by using more effective learning, and under what circumstances a student can be taught to use logical thinking. Padilla [18] hypothesized that logical thinking ability might be associated with science process skill. The rationale is that logical thinking and science process skills are involved in conducting a fair experiment, inquiry, experimentation, evidence evaluation, inference, and argumentation that support the formation and modification of scientific concepts [18,19].

Logical thinking abilities include the abilities to identify and control variables and to use combinatorial, correlational, probabilistic and proportional logic [7]. While the science process skills were divided into two types basic and integrated by Science–A Process Approach (SAPA). Basic science process skills include the abilities used when observing, classifying, communicating, measuring, inferring, and predicting [20]. Basic process skills which are typically taught in elementary grades, act as prerequisites and a foundation for learning integrated processes which are usually taught in middle school grades. The integrated science process skills include controlling variables, interpreting data, formulating hypotheses, defining operationally, and experimenting [20].

The obvious direct links between logical thinking ability and processes skill can be seen when identifying and controlling variables, and hypothesizing. Students who are not able to identify and control variables would have difficulty in formulating a hypothesis, interpreting data and constructing generalizations. Generally speaking, cognitive limitations may prevent students from learning science process skills. On the other hand, learning strategy which emphasizes science processes may promote logical thinking [4]. Although the causal relationship between the two is still uncertain, a number of studies inferred that process skill teaching might influence logical thinking ability [3].

Numerous studies have confirmed a high correlation between these two sets of abilities [3,4,7,8,10]. However, all studies worked with secondary students and integrated science process skills. While limited research has been done to investigate the relationship between logical thinking and basic process skills in primary school setting. This has led us to further investigate the relationship between these two abilities of the primary students. Therefore, the purpose of this paper is to examine logical thinking and basic science process skills and to extend the work of science education researchers by determining if the findings of previous studies hold true for primary school students.

2. Method

A correlational study with cluster random sampling technique was used to select a total of 227 primary school students in grade 5 from seven public primary schools in Mataram to participate in the study. Seven public shools were choosen carefully by considering their rank (top, middle and bottom) in the latest average scores of the National Examination. Participants completed two tests (ToLT and TBSPS) which were administered by their homerooms and the author on two consecutive days at the end of second semester (school year 2017/2018). The age of students ranges from 10 years old to 13 years old. Students who participated in present study have not undergone any special training on either logical thinking abilities or basic science process skills. The standardized tests were used in the study because it was thought that a high reliable and valid instrument for collecting data would result a high degree of relationship between sets of scores on the tests, so it provides evidence of a strong correspondence between the abilities.

2.1. The Instruments

Logical thinking ability of students was documented with a multiple response, a double multiple choice format, a paper and pencil test [7]. The Test of Logical Thinking (ToLT) consists of ten items which provide a measure of formal reasoning on five modes: proportional logic, controlling variables, combinatorial logic, probabilistic logic, and correlational logic. Two items for each mode of thinking are contained in the test. The total score is out of 10. Students would get a full score of 1 on any of the first eight items if they provide both the answer and the reason correctly. While for the last two combinatorial items, students must provide all possible combinations of several variables. This test is similar to that developed by Lawson [1] and it was chosen because of the validity and reliability results on samples of students ranging from sixth grade thorugh college and could minimize the effect of guessing [7,21]. The test takes from 40 minutes to complete. The sample of probabilistic item form ToLT is shown in Fig.1.

Item 5

The Vegetable Seeds

A gardener bought a package containing 3 squash seeds and 3 bean seeds. If just one seed is selected from the package, what are the chances that it is a bean seed?

a. 1 out of 2
b. 1 out of 3
c. 1 out of 4
d. 1 out of 6
e. 4 out of 6

Reasons:

1. Four selections are needed because the three squash seeds could have been chosen in a row.
2. There are six seeds from which one bean seed must be chosen.
3. One bean seed needs to be selected from a total of three.
4. One half of the seeds are bean seeds.
5. In addition to a bean seed, three squash seeds could be selected from a total of six.

Figure 1. Sample of the probabilistic item from the Test of Logical Thinking

Basic science process skills were measured with a multiple choice, four-option format, a 33-item paper and pencil test. The test covered six basic process skills for students in grades 4 to 8 (ages 8 to 14 years) which are observing, classifying, communicating, measuring, inferring, and predicting. The development and validation of the test is fully described elsewhere [22]. Content for the items was drawn from all science areas so that the test favors no particular science background. The test takes from 50 minutes to complete. The sample of predicting skill item form TBSPS is shown in Fig.2.

Item 23

Randy and Linda did a project in science class. They recorded the temperature of water each minute. This chart shows what they found.

Time	Temperature
1 minute	18 ^{0}C
2 minutes	22 ^{0}C
3 minutes	25 ^{0}C
4 minutes	29 ^{0}C
5 minutes	__ ^{0}C

What do you think the temperature of the water will be **after five minutes**?

a. 26 ^{0}C
b. 29 ^{0}C
c. 32 ^{0}C
d. 35 ^{0}C

Figure 2. A sample of item which assessed predicting skill from the Test of Basic Science Process Skill

2.2. Analysis

To increase the validity of the Indonesian translation of the tests and obtain a text written in an appropriate language the same procedures that was used by Valanides [5] was adopted. In addition, for further strengthen the validity of test and adjust the objectives with Indonesian science curriculum for primary schools, then the content validity was judged by the science education expert. Both test items (ToLT and TBSPS) were reviewed by four primary science education faculty member at University of

Mataram. They were provided the tests and corresponding learning objectives that matched to each test item. All of the experts agreed with minor revision that the questions in both tests are valuable and suitable with Indonesian primary science curriculum.

Scores on ToLT could be used to categorize students as being at the formal reasoning, transitional reasoning, or concrete reasoning. Test scores from 0-1, 2-3 and 4-10 were used to classify students as concrete, transitional, and formal thinker respectively [5,21].While students' score on TBSPS was not used to classify students into certain categories.

All collected data were analyzed by using descriptive statistics to find the average scores and the percentage of students in each category, and inferential statistics to determine the correlation between assessed variables. Non-parametric statistics, in particular Spearman rank correlation was used to determine the correlation between the two measures because the variables were not normally distributed.

3. Resuts and Discussion

Science process skills are defined as set of skill that scientists use to solve problem. Basic process skills are considered as a foundation to students for learning more complex process skills [3,20]. Those six basic process skills must be mastered by primary science students in grades 4, 5 and 6. Figure 3 reports the averages scores for the basic process skill total test and subtests. The TBSPS average score was 64 out of 100, and with the exception of predicting skill the average scores of TBSPS subtests showed moderate achievement. Students demonstrated highest performance in classifying skill (BPS2), while they showed the lowest performance in predicting skill. This means that students found predicting skill difficult and it also implied the recent instructional method that used to teach students did not facilitate effectively in teaching student predicting skill. Thiel & George [23] explained that the factor which affects predicting skill of the students is their experiences. Therefore, it needs to be practiced repeatedly in the classroom [23,24].

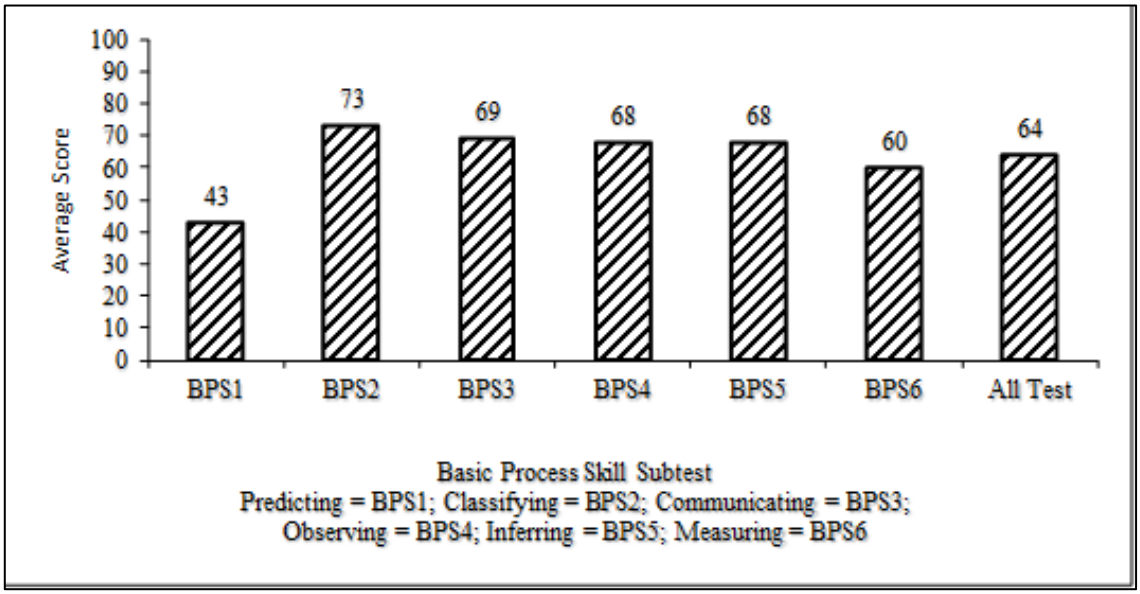

Figure 3. The average scores of students' basic process skill on TBSPS total test and subtests.

Thinking is generally assumed as cognitive process, a mental activity which used to obtain knowledge. The results showed that the developments of reasoning skills of the students in grade 5 at Mataram was 59% at the concrete operational level, 34% at transitional level and 7% at the formal operational level. Figure 4 displays the averages scores for the ToLT total test and subtests (five reasoning patterns).

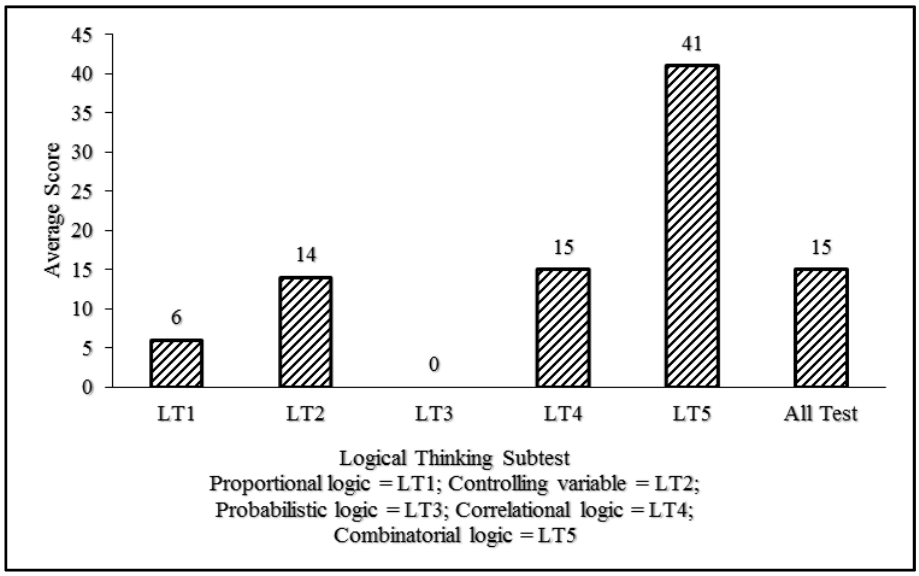

Figure 4. The average scores of students' logical thinking on ToLT total test and subtests.

A person scoring 4 out of 10 (40 out of 100) or higher in the ToLT score is cotegorized to be a formal thinker. Almost the whole students at this sample of study fail to reach formal thinking. The lowest performance among the subtests of logical thinking was the probabilistic logic as shown in Fig. 4. None of student was able to solve the probabilistic questions at all. This finding is in line with previous result reported by Tobin & Capie [25] that the probabilistic logic was relatively low at all grades 7-12. Students showed highest performance in combinatorial logic. However, the average score of ToLT total test and almost all subtests of logical thinking are relatively low. It means that students need a room for additional learning that particularly teaches the logical thinking repeatedly and explicitly.

Assessing students' logical thinking ability and process skills is an essential in learning process. The previous studies reported that science process teaching has great potential to teach student to think logically [21,25]. The finding of the study showed a weak relationship between logical thinking ability and basic process skill (r = 0.124), but it is statistically significant at the 0.05 level. This correlation is further evidence of a relationship between logical thinking and basic process skill. The low magnitude of the correlation can be possibly explained that the majority of students who are concrete operational thinker, usually capable to identify and control some variables that affect a certain phenomenon but they do not perfom the skill systematically. In addition, a concrete thinker is also able to process information without understanding the reason [26]. This level of performance in logical thinking suggested that these students would find it more difficult if compared with the level of student's performance in basic process skill. The students in this study are not given any special training either on science process skill or on logical thinking skill. However, the results showed that students' performance was higher in science process skill than thinking skill. It means that the recent classroom instructions which are taken by students has been indirectly practiced their process skill than thinking skill. Therefore, science process teaching must be designed systematically and explicitly in order to teach students to think logically.

4. Conclusion

Level of basic science process achievement of the primary school students in grade 5 at Mataram was categorized into the moderate achievement. The lowest performance of the ToLT subtest was predicting skill, which is similar to the result reported in the previous studies. While for the logical thinking, the majority of students was in the concrete operational level. The finding of the study showed that there have been a weak relationship, but statistically significant, between the logical

thinking ability and basic science process skill. The result also corroborates the evidence reported in the previous studies which worked with the secondary students and integrated process skill. The findings of previous studies, which related to the relationship between logical thinking skill and process skill, also hold true for primary school students. However, the causal relationship between these sets of abilities still need further investigation by using the experimental research design.

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