The abstraction ability about natural numbers through playing traditional music for elementary students

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Abstract. The ability of music has a positive impact on the balance of thinking. The purpose of this study is to determine whether the musical ability has a direct effect on the ability of abstraction of native numbers of elementary school students at a low level. This is survey research as an evaluation stage for the development of elementary thematic learning models in Kota Bengkulu, Indonesia. The research sample was 95 elementary school students in Kota Bengkulu. The instruments of this research were musical ability tests and abstraction ability test. Data were analyzed through the Lisrel 8.8 test. The results of this study is that musical ability has a direct positive effect on the ability of abstraction of native elementary students to a low level.

1. Introduction
The ability of music has a positive impact on the balance of thinking. Like the ability to perceive, distinguish, compose, and express. Musical ability increases musical intelligence [1]. The intelligence includes sensitivity to tone, pitch or melody pattern, tone color or the sound color of a song. It can improve the balance of the right brain and left brain. The left brain is the part that processes the ability of abstraction of natural numbers [2], math [3] and, arithmetic operations [4]. Mathematics for most students is a scourge. Especially for elementary school students grades 1 to 3. Though this is a compulsory subject for them [5]. Therefore, we need a learning approach that is suitable for them. It is learning that is close to students' thoughts and daily habits. Also close to the culture and character of the environment [6]. Musical and singing become something fun and easy for students to do. Even with the local music, or singing that they can sing. Surely it can be a starting point for them to have fun and learn without pressure. Students can balance the abilities of the right and left brain naturally [5].

Musicals stimulate neuronal activity in children more effectively. This can improve musical intelligence for children [7]. Indicators of the development of musical intelligence in early childhood based on age 5-6 years, namely (1) singing in groups, (2) following the dance movements of a simple song, (3) singing a song accompanied by music, (4) playing a musical instrument, and (5) paint with various musical instruments [8].

According to Bruner the process of achieving mathematics structurally must go through a learning process. The process includes three levels, namely the enactive level, the iconic level, and the last level is the symbolic level [9], conceptual [10]. The three levels are the process of representation which is the basis for the process of abstraction. The move from the iconic level to the symbolic level is a serious concern for educators. [11]. If not careful, this process will be meaningless. Because symbols have abstract properties and in mathematics, they are empty of meaning.
Natural numbers are basic numbers that start at 1, and are followed by sequences of 2, 3, 4, and so on [5, 12]. To achieve the concept of natural numbers students are trained through kinesthetic activities in the form of activity, advanced through the media of images and end by writing and understanding the symbols of the numbers. This shows that three indicators of abstraction ability are active, iconic and symbolic.

Learning mathematics through fun activities such as singing accompanied by music that is close to student culture has a positive effect on improving mathematical ability. In mathematics, there are three basic abilities namely abstraction, idealization and generalization [13-15]. It shows that the musical abilities and abilities of students’ natural number abstraction. Techniques utilizing music to enhance intelligence are through introducing music in learning [1], listening to music, making musical instruments for learning mathematics. Learning by using music media influences the ability of number abstraction for students [14]. Furthermore, in their opinion that music will stimulate the mind, improve concentration, memory, improve cognitive, physiological and emotional intelligence. It means influencing the child's feelings which will affect the students' enactivity-iconic-symbolic [9]. Thus music influences the abstraction process of mathematical concepts [17, 18].

Students learn through a musical approach (local culture) making it easy for him to do abstractions [9]. Students can learn about basic numbers by numerating based on the beats of musical notes. Bengkulu local music, like Dol, is a local culture that is very close to students. That makes it easy for students to do abstractions about numbers. The local culture includes mathematics in culture (often called ethnomathematics) [16]. Ethnomathematics is a philosophy of mathematics education in which mathematical literacy is a fundamental right of all students [17]. The teaching process tries to reach all students and try to involve them in the process of learning mathematics, regardless of their cultural diversity [18].

According to Athanasios, et.al. [19], there are four factors that represent the four types of representations in mathematical relationships, namely, graphics, verbal, tables, and symbolic. Verbal factors include assignments that give students verbal descriptions of an issue. Students are asked to translate verbal descriptions of problems into graphs, tables and symbolic representations. They were asked to translate it into several other forms of representation. [11].

The representation of numbers can be done by students through learning that is close to their culture [18, 23]. That is horizontal mathematical that will lead to formal mathematics. School mathematics is the first formal deductive material faced by students. That is something that is not easy to deal with, especially how to understand mathematical concepts. Students need the ability to think logically, think creatively and solve problems. Mathematics learning requires students to actively communicate, both verbal and written communication [20]. The student is able to think at a high level [21] and metacognition [22]. According to Leonard and Linda, there was a significant positive effect on logical-mathematical intelligence and musical intelligence. That affects the higher order thinking skill (HOTS) [23]. In addition, there is a significant positive effect of logical-mathematical intelligence on HOTS, but there is no significant effect between musical intelligence on these abilities. There is a relationship between the development of mathematical thinking skills with the context of 21st century learning, namely higher order thinking skills for students, especially in primary schools [24]. The music media has an influence in increasing the ability to recognize numbers in children [14]. According to Papadopoulos [15], mathematical concepts such as symmetry and group theory, in their teaching and in their composition are closely related to music. Furthermore, there is a strong relationship between mathematics and music, for more than two millennia, lively, extensive, and very enriching for both domains. Thus, we hypothesize that musical ability would have a direct positive effect on the ability of abstraction of low-level elementary school students' natural numbers.

2. Method

This research is a part of development research. A thematic learning model was developed for low-grade elementary school students. This paper is the evaluation stage of the effectiveness of the model, which is a survey study of the results of the dissemination stage. The sample of this study was 95 students chosen randomly from 857 early-grade elementary school students in Kota Bengkulu, Indonesia. The research instrument was a test of musical ability and the ability to the abstraction of natural numbers.
To collect latent variable data on musical ability and abstraction ability. Indicator variables of musical ability are (X1) sing in groups, (X2) follow the dance moves of a simple song, (X3) sing songs accompanied by music, (X4) play musical instruments, and (X5) paint with various musical instruments. Indicator variable Ability Abstraction of Native Numbers includes (X6) active, (X7) iconic, and (X8) symbolic. Data were analyzed with the LISREL Application Program.

3. Results and Discussion

This study collects survey data as one of the test parts of the effectiveness of thematic learning for elementary students in Kota Bengkulu, Indonesia. Data was taken through musical ability tests and ability tests of natural number abstraction on 95 samples. Data were analyzed using Lisrel 8.8. The results of data analysis are presented in Table 1.

| Statistics                  | Calculation Results | Criteria (fit) | Description |
|-----------------------------|---------------------|----------------|-------------|
| Minimum fit function chi-square | 0.68 (P = 0.065)    | p > 0.05       | Fit         |
| RMSEA                       | 0.071               | < 0.08         | Fit         |
| RMR                         | 0.054               | ≤ 0.10         | Fit         |
| Standardized RMR            | 0.047               | ≤ 0.10         | Fit         |
| GFI                         | 0.91                | ≥ 0.90         | Fit         |
| AGFI                        | 0.82                | 0.80 ≤ AGFI < 0.9 | Fit     |
| NFI                         | 0.95                | ≥ 0.90         | Fit         |
| NNFI                        | 0.92                | ≥ 0.90         | Fit         |
| CFI                         | 0.91                | ≥ 0.90         | Fit         |
| IFI                         | 0.95                | ≥ 0.90         | Fit         |
| RFI                         | 0.97                | ≥ 0.90         | Fit         |
| PNFI                        | 0.18                | ≥ 0.00         | Fit         |

Based on the results of data analysis, it was found that all statistical tests met the fit criteria. Thus, the theoretical model is in accordance with empirical data (= fit). Based on Table 1, all GOF sizes that show good compatibility. Thus, it can be concluded that the overall suitability of the model is good (model fit). The CFA results are then contained in the path diagram as can be seen in Figure 1 (Basic Model Standardized Solution).

![Figure 1. Basic Model Standardized Solution](image)

Furthermore, Lisrel 8.8 also produces a Basic Model T-Values path diagram. The diagram is in Figure 2.
Based on the path diagram of Figure 1 and Figure 2, summarized the validity and reliability of two latent variables, namely musical ability and the ability to the abstraction of natural numbers. This summary is in Table 2 and Table 3.

**Table 2. Validity and Reliability of Musical Ability Instruments**

| Indicator | SLF ≥ 0.50 | Standard Errors | t-value | declaration | Reliability |
|-----------|------------|-----------------|---------|-------------|-------------|
| X1        | 0.12       | 1.35            | 1.05    | Low validity |             |
| X2        | 0.61       | 1.12            | 4.00    | Good validity |             |
| X3        | 0.50       | 0.26            | 9.69    | Good validity |             |
| X4        | 0.84       | 0.25            | 9.99    | Good validity |             |

Based on Table 2, this shows that there are two observed variables (namely X1, X2, X3, and X4) for latent variables (musical abilities) that have passed the validity test. This is because it meets the requirements, namely the loading factor value ≥ 0.50 and t-value ≥ 1.96. Also, the reliability construct (CR) is 0.73 > 0.70, indicating that the reliability test of musical ability variables is consistent.

**Table 3. Validity and Reliability of Instruments Ability of natural number abstraction**

| Indicator | SLF ≥ 0.50 | Standard Errors | t-value > 1.96 | declaration | Reliability |
|-----------|------------|-----------------|----------------|-------------|-------------|
| X6        | 0.61       | 0.66            | **             | Good validity |             |
| X7        | 0.85       | 0.62            | 4.97           | Good validity |             |
| X8        | 0.87       | 0.43            | 5.20           | Good validity |             |

To explain the indicator indicators of natural number abstraction capabilities, see Table 3. This table confirms the validity of the observed variables (X6 - X8) on the variable ability of natural number abstraction. Three observed variables are valid. The three manifest variables are declared active (X6); iconic (X7); and symbolic (X8). This is in accordance with the provisions that the loading factor value ≥ 0.50 and t-value ≥ 1.96. For reliability, the construct reliability value (CR) is 0.76 ≥ 0.70, and VE = 0.5, which indicates that the reliability test of the ability of the abstraction of native numbers produces good values. Thus, the ability of abstraction of natural numbers has a good consistency. This result is very feasible, because other studies show the same thing. According to Papadopoulos that music is something special for the alliance between art and science. Mathematics plays a central role in the alliance. Thus, music is closely related to mathematics [15]. Music has a positive influence on understanding mathematical concepts [25], including the process of abstraction of natural numbers. Through music, students' ability to recognize numbers can develop very well [14].

With the level of validity and reliability for each latent variable and manifest variable, it can provide strong support for the hypothesis testing of this study. Based on Figure 2 of the Basic Model T-Values,
it is shown that the value of t arithmetic is 5.22 with high significance. This shows that the statistical hypothesis was rejected, and accepted the research hypothesis was accepted. The musical ability has a direct positive effect on the ability of abstraction of natural numbers of elementary school students at a low level. This can be achieved through a local cultural approach (ethnomathematics), in accordance with previous research (see research results \[7, 28-32\]). Thus, the results of this study emphasize the importance of local culture (ethnomathematics) as a starting point for learning mathematics.

4. Conclusion

Based on the results of data analysis, it can be concluded that musical ability (local cultural approach) has a positive direct effect on the ability of abstraction of native elementary students to a low level. This shows that low-grade students can be taught through thematic learning with musical learning media. Therefore, it is recommended to elementary school teachers to use music as a meaningful learning media.

5. References

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