The effect experiential learning model based concrete-pictorial-abstract (EL-CPA) on mathematics attitude of deaf students

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Abstract. Mathematical attitude is a psychological response that arises when students interact in learning mathematics in school. For deaf students, attitudes towards mathematics have an important role in their success in learning mathematics. Deaf students are students who have hearing loss and verbal communication. The experts revealed that the visual potential of deaf students is a potential that can be utilized in mathematics learning activities. One learning model that utilizes the visual potential of deaf students is the EL-CPA model. The research aims to determine the effect of the application of the EL-CPA model on the mathematical attitudes of deaf students in Special Schools. This research is a quasi-experimental study with a sample of 20 deaf students. The sample was chosen randomly from 10 Special Schools in the city of Bogor. Data were analyzed using non-parametric statistics through binomial tests. The results of this study indicate that there is an effect of the EL-CPA model on the mathematical attitudes of deaf students with a Sig value of 0.024. Therefore, researchers recommend applying the EL-CPA learning model for deaf students in special schools.

1. Introduction
Deaf students are students who have hearing loss (range above 90 dB) which causes their limitations to communicate and obtain linguistic information through the sense of hearing. Therefore, in communicating deaf students generally use sign language, lip reading, or even by using total communication. Internationally, students with hearing loss are usually termed as deaf student or hard of hearing. The difference between the two terms lies in the level of hearing loss that is experienced. In Indonesia, deaf students are one of the categories of students with special needs. Students with special needs are students who have a difficulty level in following the learning process due to physical, emotional, mental, social, and have special intelligence and talent potential.

Efforts to provide educational services to students with special needs in Indonesia focus on developing a variety of potentials that they have through continuous and systematic observation of teachers in the identification and assessment process. This process distinguishes teachers in general from teachers for students with special needs. Because through identification and assessment teachers are expected to be able to provide good educational services and in accordance with the conditions and characteristics of students with special needs [1].

The seriousness of the Indonesian government in providing education services for students with special needs is reflected in Law Number 20 Year 2003 concerning the National Education System in Article 5 (2) mandating that "Citizens with physical, emotional, mental, intellectual, and / or social disabilities are entitled to special education. Then it was emphasized by the issuance of Law No. 8 of
2016 concerning Persons with Disabilities in article 10 Paragraph a that: "Persons with disabilities are entitled to receive quality education in education units in all types, lines and levels of education in an inclusive and specific manner. This further opens opportunities for students with special needs to obtain quality education quality in accordance with the characteristics and specificities they have in each type and level of education. The implementation of special education in Indonesia is inseparable from the joint commitment of citizens of the world regarding education for all (Education for All) contained in The Salamanca Statement, namely students with Special Needs must have access to education that must be able to accommodate them in a pedagogy centered in children [2]. Meanwhile, the implementation of special education in Indonesia is regulated through Law No. 20 of 2003 concerning National Education System Article 32 which states that "special education is education for students who have difficulty in participating in the learning process because of physical, emotional, social, and / or potential disabilities and special talents."

Based on the data that there are so many deaf students in Indonesia, it is necessary to design learning that can access deaf students to be able to develop their potential based on the characteristics they have and provide opportunities for their success in learning. Good quality education and learning certainly gives more access to the success of deaf students. But the fact is, the implementation of learning for deaf students is still far from expectations. The results of research conducted by Retnawati on deaf students in Yogyakarta, informs that some of the problems of learning mathematics for deaf students are: (1) Deaf students learning mathematics at school still use mathematics books for normal children; and (2) the unavailability of "special" mathematics teaching materials and specific learning models that are appropriate and in accordance with the characteristics of deaf students [3].

The results of the research conducted by Retnawati above are relevant to the findings made by researchers at special school Fitria Ciawi Bogor, West Java on 26-29 April 2017 when conducting research observations. In detail the findings of the observations are: (1) teachers rarely use lesson plans, syllabus, and learning manuals given by the government in mathematics learning. This is due to the cognitive abilities of deaf students who tend to be weak so they have not been able to use the guidelines given by the government, the guidelines feel less in accordance with the conditions of learning in SLB. (2) in learning activities teachers more often adjust to the learning desires of deaf students. when deaf students are bored, learning is stopped by the teacher. As a result, not all teaching material that has been prepared is taught; (3) deaf students easily forget the material that has been taught before, so teachers often do repetition. The impact of learning becomes less effective; (4) teachers do not have and apply "special" models and approaches for deaf students; and (5) the ability to understand students' mathematical concepts in the material concept of numbers is very low, so that at the junior and senior high school level the teacher is still repeating material about the basic concepts of numbers. The learning situation of deaf students like this apparently did not only occur at special school Fitria Bogor but also at several other Special Schools. From preliminary research activities conducted by researchers at special school Tunas Kasih 2 in Bogor Regency on February 20, 2019 found learning conditions similar to special school Fitria. The findings of the preliminary research are: (1) Deaf students have difficulty learning mathematics in class not only because they are less able to hear and communicate like other normal children but also because of their "forgetfulness" (low of working memory); (2) Lack of availability of mathematics learning media that can specifically be used by deaf students in learning activities. This resulted in the learning of mathematics in the classroom being monotonous and seemed to be saturating for some students; (3) Some deaf students do not seem to understand the terms or meanings of mathematical symbols. this impacts on their lack of understanding of the material or concept being taught; (4) In mathematics learning activities in the classroom, deaf students have difficulty communicating some mathematical terms or symbols that are not familiar to them, and this has an impact on frequent miss-communication between teachers and students in the class; (5) Some deaf students look easily bored and bored in learning mathematics.

Based on these observational findings indicate a problem with mathematics learning for deaf students. one root of the problem in this context is the existence of negative attitudes of deaf students towards mathematics learning. therefore, it is necessary to design a special learning model that can make students have a positive outlook or attitude towards mathematics so that it will have an impact on their success in learning mathematics.
One of the mathematics learning models specifically designed for deaf students is the Experimental Learning model based on Concrete-Pictorial-Abstract (EL-CPA). The EL-CPA learning model is a learning model that is seen as providing direct experience to deaf students, involving hands-on activity, utilizing visual potential, and in accordance with the deaf student characteristics of deaf students. Through the EL-CPA learning model deaf students will utilize concrete experiences during the mathematics learning process. In addition, through this learning model students carry out mathematical manipulations individually or in groups using their mathematical potentials with the help of instructional media. The mathematical manipulation that will be carried out is related to representations to a semi-concrete form, for example image representation. The final stage, image representation is associated with abstract mathematical forms. This research was conducted to test whether the application of Experimental Learning model based on Concrete-Pictorial-Abstract (EL-CPA) affected the attitudes of deaf students towards mathematics.

2. Method
This research is a Quasi Experiment with posttest only control group design. The sample used was 20 deaf students spread in three special school in Bogor Indonesia because the total number of special schools for deaf students in Bogor city is ten. Samples were randomly selected from ten special school. Data was collected using a Nontes Instrument (Attitude Questionnaire) consisting of 25 statements. Example: “I will study mathematics in earnest” or “I’m not interested in working on math problems”. Data were analyzed using Non-Parametric Statistics through Binomial Test at a significance level of 0.05. This statistical test was carried out using SPSS assistance. 21. The proposed statistical hypotheses are:

Ho : p < 0,75
Ha : p ≥ 0,75

Where: p = the proportion (frequency) of students who have a mathematical attitude score greater than 70. The binomial test is carried out at the significance level (α) = 0.05 with the following binomial test formula [4].

\[ P (y) \geq \binom{n}{y} p^y q^{n-y} \]

dengan:

n = sample (n = 20)
q = 1 - p
y = many students who have a score greater than or equal to 70.

Criteria for decision make is reject Ho if the value of sig <0.05. In other words, the EL-CPA learning model has a significant effect in terms of mathematical attitude if at least 75% of students have a mathematical attitude test score above a set standard of 70.

3. Result and Discussion
The effectiveness test of the EL-CPA learning model in terms of student attitudes aims to determine whether the application of the EL-CPA learning model in Special Schools (SLB-B) for deaf students is effective in terms of student attitudes toward mathematics and mathematics learning. The statistics used are non-parametric statistics using a proportion test (binomial test) with the help of SPSS 21.0 for windows program at a significance level α = 0.05. The decision making criteria, namely the EL-CPA learning model, were significantly reviewed by students' attitudes if a minimum of 75% of students had a math attitude test score above a set standard of 70. Or H0 was rejected if a sig value <0.05. A summary of the effectiveness test results of the EL-CPA learning model in terms of student attitudes can be seen in the following Table 1.
Table 1. The effectiveness test results of the EL-CPA learning model in terms of students’ mathematical attitudes

| Kategori | N   | Observed Prop | Test Prop | Sig. (1-tailed) |
|----------|-----|---------------|-----------|----------------|
| Skor     |     |               |           |                |
| Attitude |     |               |           |                |
| Group 1  | < 70| 1             | 0.05      | 0.75           | 0.024 |
| Group 2  | ≥ 70| 19            | 0.95      |                |       |
| Total    | 20  | 1.00          |           |                |

Based on table 1, information is obtained that students who have grades less than 70 are 1 student or 5% while those greater than 70 are 19 students or 95%. With a proportion test of 0.75 a sig is obtained. 0.024 <0.05. So, H0 is rejected. Thus it can be concluded that the EL-CPA learning model is significantly effective in terms of students’ attitudes towards mathematics and mathematics learning.

Table 2. Description of the effectiveness of the EL-CPA learning model in terms of the mathematics attitudes of deaf students

| N   | Mean | Std. D | Min | Maks |
|-----|------|--------|-----|------|
| 20  | 83.33| 7.65   | 62.67| 94.67|

The table 2 shows that the average score of students’ attitudes towards mathematics is 83.33 with a standard deviation of 7.56. Meanwhile, of the 20 deaf students who were sampled in this study, a minimum score of 62.67 and a maximum score of 94.67 was obtained.

Attitudes are affective components that show emotional reactions, like or dislike, to certain objects [5] [6]. Meanwhile, specifically attitudes towards mathematics are affective components that show emotions and feelings towards mathematics subjects. Specifically, attitude refers to feelings of liking or being attracted to mathematics, or feelings of dislike or not being interested in mathematics. Not only that, some psychologists argue that attitudes towards mathematics can be identified by classical conditioning, observation and observation [7] [8]. In this study, the mathematical attitudes of deaf students were identified by classical conditioning through the mathematics attitude questionnaire.

Based on the results of data analysis of the effectiveness of the EL-CPA learning model using non-parametric statistics through the proportion test at the significance level of 0.05, it was stated that the EL-CPA learning model was significantly effective in terms of the attitudes of deaf students towards mathematics learning with Sig = 0.024. This shows that there are positive implications for changes in the way of thinking of mathematics by deaf students after conducting mathematics learning using the Concrete-Pictorial-Abstract (EL-CPA) learning model. There are several factors that have the potential to be the reason why the application of the EL-CPA learning model is effective in terms of the attitudes of deaf students towards mathematics learning. First, through the EL-CPA model, deaf students learn mathematics in a fun way (learning fun) which is facilitated by visual learning media in doing multiple mathematical representations [9] [10]. That is, mathematics learning does not necessarily begin with mathematical objects that are abstract (symbols) but through the EL-CPA learning model deaf students begin learning by directly seeing the real objects of a mathematical object. Furthermore, from the real object, the deaf student manipulates the model (concret), then represents it in the form of images, and ends with the appropriate symbol representation. In this context, mathematics learning conducted by deaf students no longer runs monotonously and is monitored by the teacher. However, deaf students are actively involved in learning to find their own understanding of mathematics with the guidance of the teacher. Learning mathematics like this makes learning activities in the classroom more interesting and enjoyable for deaf students.

The results of this study are in line with the findings of other researchers there is an increase in students’ positive attitudes towards mathematics and mathematics learning after learning by using the Concret-Pictorial-Abstract (CPA) approach [11][12]. In addition, by using the EL-CPA learning model there is an increase in the level of positive behavior of students towards mathematics [13] and students recognize the importance of Mathematics and they want to succeed in Mathematics but there are those...
who are anxious during mathematics learning and some of them have low levels of learning motivation. Likewise, in this study it was found that deaf students also had the desire to be successful in learning Mathematics and they realized the importance of mathematics in everyday life. However, due to physical limitations (hearing loss) they experience, some deaf students also have anxiety when learning mathematics in class.

The second factor that is seen as the cause of why the application of the EL-CPA learning model is effective in terms of the attitudes of deaf students towards mathematics learning, namely the existence of mathematical exploration activities in the application of the EL-CPA model that involves the hands-on & minds-on activities of deaf students while doing mathematics learning. This activity is carried out by deaf students using the help of learning media (miniboard) that is in accordance with the characteristics of deaf students and allows them to design concrete models of a mathematical object and represent it in the form of pictures (pictorial). This activity also makes mathematics learning more interesting for deaf students. The results of this study support the findings of other studies that found that hands-on & minds-on activity can improve student achievement and positive attitudes towards learning mathematics and science [14]. In addition, the Concrete-Pictorial-Abstract (CPA) approach can be an alternative learning to increase students' interest in learning mathematics [15-17].

4. Conclusion
Based on the research results obtained it can be concluded that the Experiential Learning model based on Concrete-Pictorial-Abstract (EL-CPA) has a significant effect in terms of the mathematical attitudes of deaf students.

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6. References
[1] Kemendikbud 2017 Pedoman implementasi kurikulum 2013 pendidikan khusus: peraturan dirjen pendidikan dasar dan menengah tentang struktur kurikulum, kompetensi inti kompetensi dasar, dan pedoman implementasi kurikulum 2013 pendidikan khusus (Jakarta: Kemendikbud)
[2] The Salamanca Statement and Framework for Action On Special Needs Education 1994 World Conferenceon Special Needs Education: Access And Quality (Spain: Ministry of Education and Science)
[3] Retnawati H 2012 Mengembangkan bahan ajar matematika bagi siswa tunarungu tingkat SMP dalam Melaksanakan Sistem Pendidikan Inklusi di Yogyakarta (Yogyakarta: Universitas Negeri Yogyakarta)
[4] Marques J P 2007 Applied statistics using SPSS, STATISTICA, MATLAB and R (New York: Springer-Verlag Berlin Heidelberg) p 83
[5] Fazio H, Olson A 2003 Attitudes: foundations, functions, and consequences. In M. A. Hogg & J. Cooper (Eds.), The Sage Handbook of Social Psychology (London: Sage) pp. 139–160
[6] Katz D 1960 The functional approach to the study of attitudes Public Opinion Quarterly 24 163–204
[7] Lineros J, Hinojosa M 2012 Theories of learning and student development. National Forum of Teacher Education Journal 22 1–5
[8] Mensah J, Okyere M, Kuranchie A 2013 Student attitude towards mathematics and performance: does the teacher attitude matter Journal of Education and Practice 4 132–139
[9] Bartle E 2015 Experiential learning: an overview (Australia: the University of Queensland) pp.88-93
[10] Flores M M 2010 Using the Concrete–Representational–Abstract Sequence to Teach Subtraction With Regrouping to Students at Risk for Failure Remedial and Special Education 31 195-207.

[11] Nino R R, Salingay D, Tan A 2018 International Journal of Scientific & Technology Research 7 90-111

[12] Riccomini P J 2008 Improving the Mathematics Instruction for Students with Emotional and Behavioral Disorders: Two Evidenced-Based Instructional Approaches Improving the Mathematics Instruction (Boston: Houghton Mifflin company) pp. 58-68

[13] Ciubal F N R, Tan D A 2018 Asian Academic Research Journal of Multidisciplinary 5 44-53

[14] Ates O, Eryilmaz A 2011 Asia-Pacific Forum on Science Learning and Teaching 12 1-22

[15] Azmidar A, Darhim, Dahlan J A 2017 Journal of Physics: Conf. Series 895 1-6

[16] Borgna G 2011 Enhancing deaf students’ learning from sign language and text: Metacognition, modality, and the effectiveness of content scaffolding Journal of Deaf Studies and Deaf Education 16 79–100.

[17] Leong Y H, Ho W K, Cheng L P 2015 Concrete-Pictorial-Abstract: Surveying its origins and charting its future. The Mathematics Educator, 16 1-18.