The influence of teachers pedagogic competence on cognitive loads of students in the geography learning process

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Abstrak This research is a case study about the effect of students' cognitive load in the process of learning geography in the city of Bandung. The purpose of this study is (1) how the pedagogical competence of geography teachers in the city of Bandung, (2) the cognitive load of students, and (3) know the extent of the influence of teacher pedagogical competence on the cognitive load of students in the learning process of geography. This study uses a survey method, with a quantitative approach. The sample in this research were 8 high schools in Bandung. The results showed the pedagogical competence of geography teachers included in the competent category, even though the cognitive load of students in the learning process of geography included in the low category and the pedagogical competence of teachers gave influence on the cognitive load of students by 74%. The conclusion is a good teacher's pedagogical competence can reduce students' cognitive load and cognitive load is formed due to the influence of the learning methods and strategies provided by the teacher.

1. Introduction
Education ranking, according to the programme for international study assessment (PISA) in 2015, shows that Indonesia is one of the countries with low ranks, ranking 69th out of 76 countries [1]. Increasing competition every year requires all parties in various fields to improve their quality. One important concern is improving the quality of education. Improving the quality of education needs to look at specific standards. Minister of National Education Regulation Number 16 of 2007 concerning the standards of academic qualifications and teacher competencies. A teacher must have competency standards namely pedagogical competence, social competence, personality competence and professional competence. Improving the quality of education can be started with the teacher. The teacher must have good pedagogical competence. Pedagogic is the science of education that focuses on thinking, understanding students, namely how the teacher guides, and educates students. A teacher must have good pedagogical competence [2].

Pedagogic is the science of education that focuses on the way of thinking and, understanding students, namely how teachers guide, and educate students [2]. The learning process can take place well and efficiently because of the collaboration between the teacher and students, mature learning strategies and techniques can support the comfort of the
classroom environment and the quality of learning. One of the problems that result in the low quality of education in Indonesia is the quality of the teachers. Teachers who have low competence tend to force students to perform certain tasks that force students' cognitive systems to work harder [3]. Three sources, namely cause cognitive load in working memory; 1) Intrinsic cognitive load; 2) Extraneous cognitive load, and 3) germane cognitive load [6].

Intrinsic cognitive load is a burden that is formed due to the high complexity of teaching materials, so students are not able to store information in accordance with the capacity of their working memory [4]. The tendency of educators in determining learning strategies that are less attractive and less interactive will result in the continuity of the learning process if the learning process is disrupted will have an impact on information management and will certainly affect the high extraneous cognitive burden. [5] The high extraneous cognitive load can be formed from the learning strategies provided [6]. Besides German cognitive load has an important role in the learning process. This burden is also referred to as the burden in constructing cognitive schemes and can arise due to intrinsic cognitive load or extraneous cognitive load [7]. Therefore, this study aims to determine the pedagogical competence of geography teachers, the cognitive load of students, and the influence of teacher pedagogical competence on the cognitive load of students in the process of learning geography in the city of Bandung.

Figure 1. Distribution of Research Samples

2. Methods
This research uses a survey method with a quantitative approach. Respondents in this study were teachers and class X students in high schools in the city of Bandung. Sampling using random sampling, Determination of participants in convenience (based on the willingness of teachers) with regard to teacher certification and the classes being taught. A total sample of 8 teachers and class X students who took part in the learning with the teacher concerned
(Map 1). Data collection was obtained from field observations and questionnaires. Data analysis uses descriptive and inferential statistics with the help of SPSS.

3. Result and Discussion

3.1. Pedagogical Competence

The assessment was conducted for 8 geography teachers of class X hydrosphere material, namely teacher A, teacher B, teacher C, teacher D, teacher E, teacher F, teacher G and teacher H. Teacher pedagogical competency data in the geography learning process, showed the amount of competency possessed by every teacher. The assessment using a questionnaire is divided into 44 statements for scoring based on a Likert point scale of 5. Even though for the assessment of observations seen from the learning process which is divided into 3 stages, namely the opening, implementation and closing stages that have been reflected from the pedagogical dimension, data acquisition through observation is done in the form of a cross-check of the subjective rating scale through the questionnaire. Assessment is done by looking at the emergence of pedagogical competencies with a minimum score of 1 and a maximum of 5. The acquisition of teacher pedagogical competency values can be seen from the following Table 2

| No  | Frequency   | Interval | Frequency Observation | %   | Frequency Questionnaire | %   |
|-----|-------------|----------|-----------------------|-----|-------------------------|-----|
| 1   | Incompetent | 1-19     | -                     | 0%  | -                       | 0%  |
| 2   | Less Competent | 20-39 | -                     | 0%  | -                       | 0%  |
| 3   | Sufficiently Competent | 40-59 | -                     | 0%  | -                       | 0%  |
| 4   | Competent   | 60-79    | -                     | 0%  | 8                       | 100%|
| 5   | Very Competent | 80-100 | 9                     | 100%| -                       | 0%  |
|     | Total       | 8        | 100%                  | 8   | 100%                    |      |

Based on the above table, the results of observations can be seen from the 8 teachers who were used as research samples showing 100% competent frequency. Based on the results of the research showed that there is a difference between the value of observation and pedagogical competency questionnaire. However, the results of the average pedagogical competence of teachers are still included in the competent category.

3.2. Cognitive Load

3.2.1 Cognitive Loads of Mental Enterprises (Extrinsic Cognitive Load) Measurement of mental effort or extrinsic cognitive load in students is done during the learning process of geography, instruments are given to students at the end of learning. Data on mental effort was obtained based on students' opinions on a questionnaire that was designed based on the steps or learning strategies undertaken by the teacher in the classroom during the learning process. This assessment is done to see students' opinions about the learning process of geography conducted by the teacher.

The results of measurements of mental effort (extrinsic cognitive load) can be said to be high, if students cannot understand the material or explanation delivered by the teacher so that it is considered difficult, on the contrary if the value of mental effort (extrinsic cognitive load) is categorized as low then the student participant can be understand the material or explanation of the teacher that is considered easy. The results of measurements of mental effort can be seen in the following table:
Table 3. Mental Efforts (*Extrinsic Cognitive Load*)

| No | Criteria   | Interval | Frequency | %  |
|----|------------|----------|-----------|----|
| 1  | Very Low   | 30-39    | -         | 0% |
| 2  | Low        | 40-55    | -         | 0% |
| 3  | Medium     | 56-65    | -         | 0% |
| 4  | Good       | 66-79    | 1         | 13%|
| 5  | Very Good  | 80-100   | 7         | 87%|
|    | Total      |          | 8         | 100%|

It can be seen from the 8 schools that were used as research samples showing very good frequency with 87% or 7 schools and 13% or 1 school with good frequency (Table 3). based on the results of the research showed that the mental effort of students (ECL) included in the category of very good meaning that the cognitive load of students in the learning process of geography is relatively low.

3.2.2 Cognitive Load Data Receiving and Processing Information (intrinsic cognitive load)

MMI ability assessment was obtained from the instrument in the form of essay questions. Questions are given to students when the learning process is complete or the end of learning. The questions are adjusted to the delivery of material given by the teacher with indicators of identification of information components, interpretation and analysis of relevance, and application of information. Recapitulation of data on the ability to receive and process information can be seen from the following:

Table 4. Frequency of Ability to Receive Processing Information (Intrinsic Cognitive Load)

| No | Criteria   | Interval | Frequency | %  |
|----|------------|----------|-----------|----|
| 1  | Very Low   | 30-39    | -         | 38%|
| 2  | Low        | 40-55    | -         | 38%|
| 3  | Medium     | 56-65    | 3         | 38%|
| 4  | Good       | 66-79    | 5         | 52%|
| 5  | Very Good  | 80-100   | -         | 0% |
|    | Total      |          | 8         | 100%|

It can be seen from 8 schools that were used as research samples showing moderate frequency with 38% or 3 schools and 52% or 5 schools with good frequency (Table 4). based on the results of the study showed that the ability of students to receive and process information is still in the good category. Therefore, the cognitive load of learners is on Geography learning process is said to be low.

3.2.3 Learning Outcomes Cognitive Load (Germane Cognitive Load)

Data on learning progress of students is measured using a reasoning test to measure Germane cognitive load of students in learning geography. Germane cognitive load or measurement of learning progress is taken at the end of the hydrosphere chapter geography learning material. Questions in the form of multiple choices that are adjusted to the Germane cognitive load indicator that is classifying, comparing, abstracting, deduction, error analysis, construction, and perspective analysis.
Table 5. Frequency of Learning Outcomes (Germane Cognitive Load)

| No | Criteria  | Interval | Frequency |
|----|-----------|----------|-----------|
| 1  | Very Low  | 30-39    | -         | 0%        |
| 2  | Low       | 40-55    | -         | 0%        |
| 3  | Medium    | 56-65    | -         | 0%        |
| 4  | Good      | 66-79    | 1         | 13%       |
| 5  | Very Good | 80-100   | 7         | 87%       |
|    | Total     |          | 8         | 100%      |

It can be seen from 8 schools that were used as research samples showing very good frequency with a number of 87% or 7 schools and 13% or 1 school (Table 5). Based on the results of the study showed that the ability of students in learning progress in both categories, meaning that the cognitive load of students in the learning process of geography is very low. The findings show the assessment of learning outcomes is not entirely pure, students are still working together or cheating in filling out the assessment questionnaire.

3.3. Effect of Pedagogical Competence on Cognitive Load

Based on the results of the analysis obtained from 8 teacher respondents in 8 high schools in the city of Bandung. The percentage of influence given by the teacher's pedagogic competency variable Cognitive load of students can be seen by looking at the following table 6.

Table 6. Regression

| Model | R     | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------|----------|------------------|----------------------------|
| 1     | .863* | .746     | .703             | 1.84049                    |

Based on the above table 6, the calculated R correlation value of 0.863 means that the influence of the teacher's pedagogical competence on the cognitive load of students is 0.863, which is very significant. In addition, the coefficient of determination (R²) of 0.746 or 74%. This shows that teacher pedagogical competence affects the cognitive load of students by 74%, while the remaining 26% is influenced by other factors, in other words, the cognitive load of students can be influenced by other factors outside the geography learning process.

Table 7. Anova

| Model | Sum of Squares | df | Mean Square | F  | Sig  |
|-------|----------------|----|-------------|----|------|
| 1     | Regression     | 59.551 | 1 | 59.551 | 17.580 | .000 |
|       | Residual       | 20.324 | 6 | 3.387 |       |      |
|       | Total          | 79.875 | 7 |          |       |      |

Based on table 7 the calculation results show the results of the F test for the variable X against the variable Y obtained the value of F count 2.496 and F table 5.99. because F arithmetic< from F table, it can be said that the significant effect on Y. Furthermore, if the criteria using significance value (Sig) obtained significance value from the calculation is 0.006 while the criterion to be declared significant is <0.05. Thus based on the results of calculations, then X has a significant effect on Y.
This, the resulting linear regression equation is $Y = 29,647 + 0,614 X$ based on the regression equation it can be concluded that the pedagogical competence of teachers influences the cognitive load of students in the learning process of geography.

**Table 8 Coefficient**

| Model | B      | Std Error | Beta | t    | Sig  |
|-------|--------|-----------|------|------|------|
| (Constant) | 29.847 | 11.878    |      | 2.496 | .047 |
| KP    | .814   | .146      | .663 | 4.193 | .008 |

4. Conclusion
The pedagogical competence of geography teachers is included in the category of competent or good. This is seen from the teacher's understanding of students, mastery of learning theory, the ability to develop curriculum of subjects, carry out learning that educates, facilitate the development of potential learners, how to communicate and conduct evaluations can be implemented well. However, some geography teachers in Bandung still have problems in utilizing digital technology and information, conducting the methods and learning strategies used in high schools in Bandung still use conventional methods.

As for the cognitive load of students included in the low category. This can be seen from the value of mental effort and learning outcomes with very good categories, while the ability to receive and process information is still in the good category. Based on the results of the calculation of SPSS could make an influence between the teacher's pedagogical competence and the cognitive load of students in the learning process of geography by 74% and another 36% is influenced by other factors outside the geography learning process.

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