# How to Measure Profile-Based Teacher Pedagogical Content Knowledge?

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**ABSTRACT:** This study aims to determine the profile of teachers' pedagogic content knowledge (PCK) through PCK measurement management. This study uses a quantitative approach with a survey method. The respondents of this study were 105 science teachers at junior high schools in DKI Jakarta who were taken by random sampling. Teacher PCK is measured through 5 (five) domains, namely: curriculum, pedagogy, subject matter, students, and schools, which are arranged in 66 test and non-test instruments. Data collection techniques were carried out through the distribution of test and non-test instruments with a Likert scale. The results of the validity and reliability test with the Pearson and Cronbach's alpha correlation test showed that the instrument was proven to be valid and reliable. The usability and significance test results show consistent and useful results. The results showed that most of the science teachers' PCK was very high, while the very low was less than 2%. Teachers' PCK levels are also influenced by educational strata, age, and seniority. The recommendation of this research is to provide training on making PCK instruments for teachers, as an effort to optimize the knowledge of science teachers in increasing the PISA scores of Indonesian students.

**KEYWORDS:** PCK measurement, sains teacher, PISA

## I. INTRODUCTION

"Our homework is equal distribution of the number of teachers, teacher quality, and resources," said Nadiem Anwar Makarim, delivered at the 2018 Indonesian PISA Study Results Release, at the Ministry of Education and Culture Office, Jakarta. On December 3, 2019, the Ministry of Education and Culture released the results of the International Student Assessment Program (Program for International Students Assessment, PISA), which informs the results of global measurements for the average score of Indonesian students of 371 in reading, 379 in mathematics, and 396 in science (https://puspendik.kemdikbud.go.id/about-pisa) Indonesian students' competency scores in reading, math, and science in 2018 were lower than similar measurements in the previous three years.



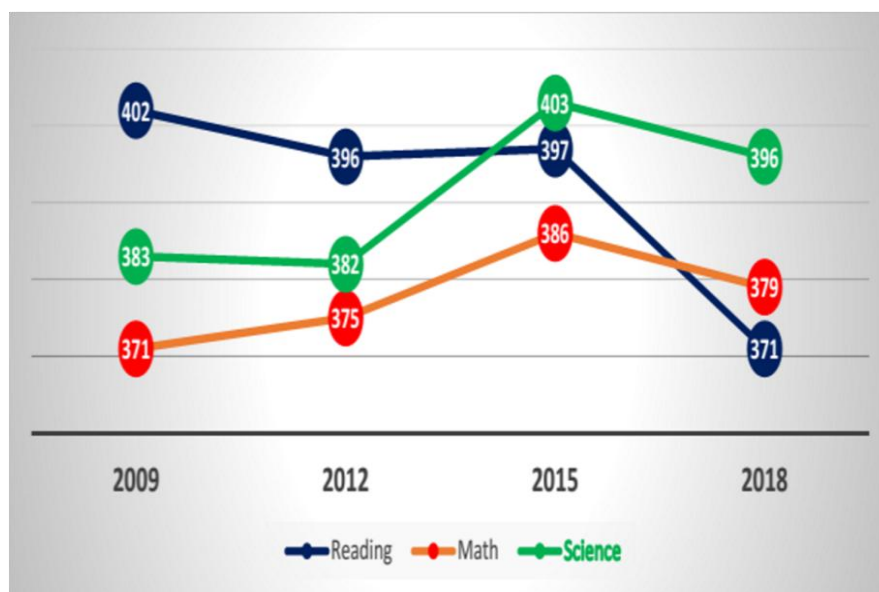**Fig 1. Trends in Indonesia's PISA score decline**
**(https://puspendik.kemdikbud.go.id/tentang-pisa)**

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### *A. Teachers Pedagogical Content Knowledge (PCK) in Indonesia*

The low PCK colors various research results on teacher PCK in Indonesia, including the results of research on the PCK profile of junior high school science teachers in Siak Regency, Riau, also showing poor results with an average of 54.66% after the Pedagogical Content Knowledge (PCK) competency test was carried out (Agustin, *et al*, 2018). Research on science teacher PCK at SMA Negeri 11 Jambi City shows that teacher PCK is still low, where of the seven aspects of teacher PCK there are only four aspects that are mastered, namely knowledge of learning strategies, knowledge of subject matter and educational learning, knowledge of communication with participants students and knowledge of assessment and evaluation, as well as three aspects of teacher.

Furthermore, the results of measuring the PCK competence of elementary school teachers in DKI Jakarta and in West Java show that teachers who have obtained a teacher professional certificate between 2-4 years have a lower PCK score compared to teachers who have received teacher professional certification under 1 year, who recently participating in teacher professional training (PLPG) activities (Yuliariatiningsih, et al, 2019). Many research results recommend the importance of measuring teachers' PCK levels accurately, so that efforts to improve PCK can be carried out through appropriate training (Mu et al, 2018; Lepareur, Cross & Munier, 2017).

The basic factors behind the importance of this research are the data on the low PCK of teachers in Indonesia, the teacher competency test scores (UKG) below the average, and Indonesia's PISA scores which have decreased in the last three years (Sudrajat, 2020; Yuliariatiningsih. et al, 2019; Haryani, Prasetya & Rusmawati, 2016; Puspendik, 2019; UKG data, 2019). This study aims to improve teacher's PCK through profile-based measurement of science teacher's PCK.

## II. METHOD

This research is a type of quantitative research with a survey method. The respondents of this study were 105 science teachers in DKI Jakarta with the criteria for science teachers who had at least 5 years of teaching experience. The data collection technique used a test and non-test questionnaire with a Likert scale. The preparation of indicators for the PCK measurement instrument was adapted from Shulman's PCK framework model developed by Shulman (1987) and then compiled in the form of a questionnaire on perceptions of pedagogical content knowledge and an integrated test of science knowledge core content of PISA. Furthermore, validation of the test and non-test questionnaire instruments that have been designed is carried out. Core content validation is carried out by conveying the instrument grid, instrument items, and validation sheets to experts (Stein, 2016). Furthermore, the results of the reliability of the instrument were analyzed to find the consistency of the measurement results to then be tested for usability (usability) and test for meaningfulness (meaningfulness).

The design of the PCK measurement instrument for science teachers was adopted from Shulman's PCK model, which has been simplified into 5 (five) PCK domains, namely: 1) Curriculum, 2) Pedagogy, 3) Subject matter, 4) Student, and 5) School (Han-Tosunoglu & Lederman, 2021). Based on discussions with data sources, it was decided that measurements would be taken on three core topics of the PISA competition, namely: 1) Greenhouse effect, 2) biodiversity, and 3) health risks. The framework of the integrated science teacher PCK measurement instrument for PISA core content.

## III. RESULTS

+The respondent's data from the research was processed with descriptive statistics and inferential statistics. The results of data processing are sorted based on the characteristics of the respondent's profile. In detail, it can be seen in the results of data processing as follows.
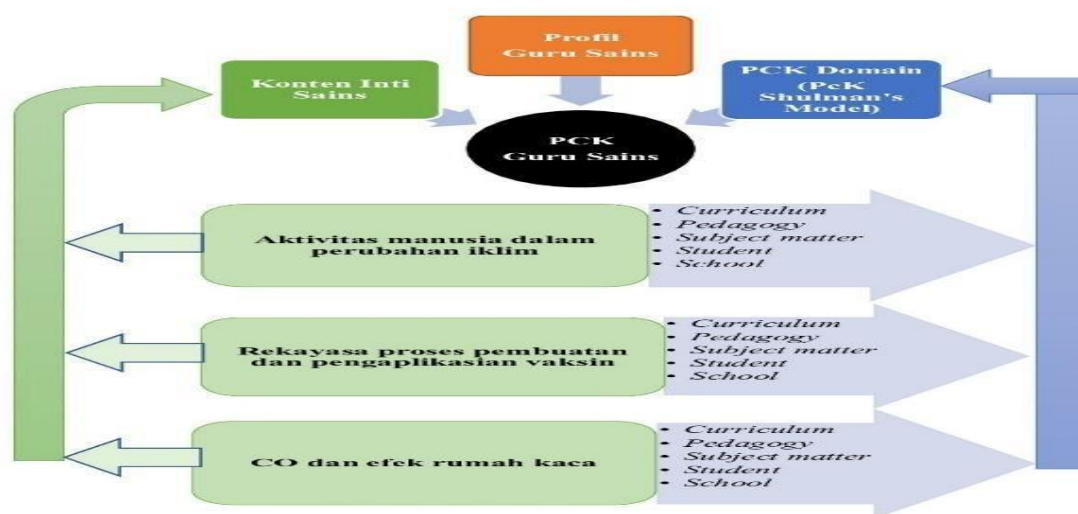


**Fig 2. The framework of the PCK measurement instrument**
**Integrated science teacher PISA core content**
*(Processed by researchers, 2021)*

**How to Measure Profile-Based Teacher Pedagogical Content Knowledge?**

*A. Results of Research Respondent Profile Data Processing*

1. **Teacher Profile by Education Strata**

**Table I. Teacher Profile By Education Strata**

|  |  | Frequency | Percent | Cumulative Percent |
|---|---|---|---|---|
| Valid | S1 | 72 | 68.6 | 68.6 |
|  | S2 | 33 | 31.4 | 100.0 |
|  | Total | 105 | 100.0 |  |

**Source:** Processed by researchers, 2021

Table 1 shows the number of respondents based on the education strata category is 68.6% S1 level, and 31.4% S2 level. Visualization of respondents based on educational strata can be seen below.



**Fig 3. Teacher circle diagram based on educational strata  (Data processed by researchers,  2021)**

2. **Teacher Profile by Age**

**Table II. Teacher Profile By Age**

|  |  | Frequency | Percent | Cumulative Percent |
|---|---|---|---|---|
| Valid | >50 th | 50 | 47.6 | 47.6 |
|  | 40-50 th | 42 | 40.0 | 87.6 |
|  | 25-39 th | 13 | 12.4 | 100.0 |
|  | Total | 105 | 100.0 |  |

**Source:** Processed by researchers, 2021)

Based on the age category in the research teacher profile, 47.6% are over 50 years old, then 40.0% are 40-50 years old and another 12.4% are 25-39 years old. Visualization of the composition of respondent data by age can be seen below.
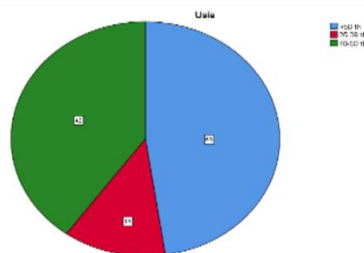


**Fig 4. Teacher pie chart by age**
**(Data processed by researchers,  2021)**

3. **Teacher Profile Based on Years of Service**

**Table III. Teacher Profile Based On Years of Service**

|  |  | Frequency | Percent | Cumulative Percent |
|---|---|---|---|---|
| Valid | >20 th | 59 | 56.2 | 56.2 |
|  | 11-20 th | 29 | 27.6 | 83.8 |
|  | 2-10 th | 17 | 16.2 | 100.0 |
|  | Total | 105 | 100.0 |  |

**Source:** Data processed by researchers,  2021)

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Based on the category of tenure, 56.2% of teachers have a tenure of more than 20 years, then 27.6% and 16.2% for teachers with 11-20 years and 2-10 years of service. Visualization of the composition of respondents based on years of service can be seen below.
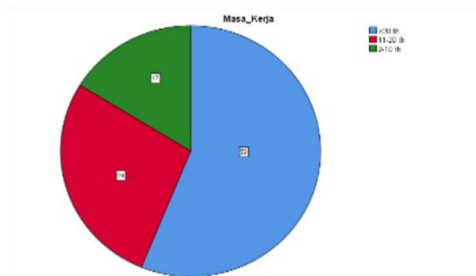


**Fig 5. Teacher pie chart based on years of service**
**(Data processed by researchers, 2021***)*

*B. The Result of The Validity and Reliability Test of The PCK Variable*
**Table IV. Test The Validity And Reliability Of Science Teacher Pck Variables**

| Variable | Dimension | Rhitung | Rtabel | Cronbach Alpha |
|----------|-----------|---------|--------|----------------|
| PCK | SM_Tes | 0,800 | 0,174 | 0,693 |
| | SM_Non Tes | 0,570 | | |
| | PED_T | 0,790 | | |
| | PED_Non Tes | 0,514 | | |
| | ST | 0,581 | | |
| | SC | 0,643 | | |
| | CUR | 0,564 | | |

**Source:** Data processed by researchers (2021)

The PCK variable shows that all dimensions are valid because Rcount > Rtable and CA is 0.693 so it is said to be reliable.

*C. Science Teacher's PCK Score Results*
**Table V. Science Teacher's PCK Frequency Distribution**

| Category | Interval | Frequency | Percentage |
|----------|----------|-----------|------------|
| Very low | 65 - 117 | 0 | 0 |
| Low | 118 - 169 | 0 | 0 |
| Currently | 170 - 221 | 1 | 0,95 |
| High | 222 - 273 | 38 | 36,19 |
| Very High | 274 - 325 | 66 | 62,86 |
| Total | | 105 | 100 |

**Source:** Data processed by researchers (2021)

Table 5 on the PCK of science teachers shows that 62.86% of teachers have very high understanding, and 36.19% are in the high category. However, there are also 0.95% of teachers or 1 of the total teachers in this study who are classified as moderate.

*D. The Results of Science Teacher PCK Scores Based on Profile*
1. The Results of Science Teachers' PCK Scores Based on Education Strata

**How to Measure Profile-Based Teacher Pedagogical Content Knowledge?**

**Table VI. Distribution Of The PCK Frequency Of Science Teachers By Educational Strata**

| Category | Interval | S1 | | S2 | |
|---|---|---|---|---|---|
| | | Fk | Percentage | Fk | Percentage |
| Very low | 65 - 117 | 0 | 0 | 0 | 0 |
| Low | 118 - 169 | 0 | 0 | 0 | 0 |
| Currently | 170 - 221 | 0 | 0 | 1 | 3,03 |
| High | 222 - 273 | 26 | 36,11 | 12 | 36,36 |
| Very High | 274 - 325 | 46 | 63,89 | 20 | 60,61 |
| Total | | 72 | 100 | 33 | 100 |

**Source:** Data processed by researchers (2021)

The PCK of science teachers is based on strata, at the S1 strata, with a total of 72 teachers, 63.89% of teachers have a very high category while 38.37% are in the high category of science teacher PCK. At the S2 strata, with a total of 33 teachers, 60.61% of the teachers were in the very high category, while 36.36% were in the high category and the remaining 3.03% were in the moderate category in the science teacher PCK which was tested on teachers.

**2. Science Teacher PCK Scores by Age**

**Table VII. Science Teacher PCK Frequency Distribution By Age**

| Category | Interval | Age 25-39 Years old | | Age 40-50 Years old | | Age > 50 Years old | |
|---|---|---|---|---|---|---|---|
| | | Fk | % | Fk | % | Fk | % |
| Very low | 65 - 117 | 0 | 0 | 0 | 0 | 0 | 0 |
| Low | 118 - 169 | 0 | 0 | 0 | 0 | 0 | 0 |
| Currently | 170 - 221 | 1 | 3,33 | 0 | 0 | 1 | 2,00 |
| High | 222 - 273 | 5 | 38,46 | 12 | 28,57 | 21 | 42,00 |
| Very High | 274 - 325 | 8 | 61,54 | 30 | 71,43 | 28 | 56,00 |
| Total | | 13 | 100 | 42 | 100 | 50 | 100 |

**Source:** Data processed by researchers (2021)

PCK of science teachers based on teacher age, at the age of 25 – 39 years with a total of 13 teachers obtained 61.54% of teachers have a very high category while 38.46% have a high category and 3.33% have a medium category. At the age of 40-50 years, with a total of 42 teachers, 71.43% of teachers were in the very high category while 28.57% were in the high category in the science teacher PCK. At the age of > 50 years, with a total of 50 teachers, 56.00% of the teachers were in the very high category, while 42.00% were in the high category and the remaining 2.00% were in the moderate category in the science teacher PCK.

**3. The Results of Science Teachers' PCK Scores Based on Years of Service.**
**Table VIII. Science Teacher PCK Frequency Distribution By Years Of Service**

| Category | Inter val | Years of service 2 - 10 | | Years of service 11 - 20 | | Years of service > 20 | |
|---|---|---|---|---|---|---|---|
| | | Fk | % | Fk | % | Fk | % |
| Very low | 65 - 117 | 0 | 0 | 0 | 0 | 0 | 0 |
| Low | 118 - 169 | 0 | 0 | 0 | 0 | 0 | 0 |
| Currently | 170 - 221 | 0 | 0 | 1 | 3,45 | 0 | 0 |
| High | 222 - 273 | 5 | 29,41 | 11 | 37,93 | 25 | 42,37 |
| Very High | 274 - 325 | 12 | 70,59 | 17 | 58,62 | 34 | 57,63 |
| Total | | 33 | 100 | 29 | 100 | 59 | 100 |

**Source:** Data processed by researchers (2021)

The PCK of science teachers is based on the teacher's tenure, for a period of 2-10 years with a total of 33 teachers, 57.58% of the teachers have a very high category and the remaining 39.39% are in the high category and the remaining 3.03% are in the medium category. In the working period of 11-20 years, with a total of 33 teachers, 69.70% of the teachers were in the very high category, 27.27% were in the high category and the remaining 3.03% were in the moderate category in the science teacher PCK. In the working period > 20 years, with a total of 61 teachers, 57.38% of the teachers were in the very high category while 42.62% were in the high category in the science teacher PCK.

## IV. CONCLUSIONS

The results of measurements of the PCK of junior high school science teachers in DKI Jakarta show that the majority of teachers have a very high PCK level, and there are only a few teachers who have a moderate level of PCK. This finding shows that the level of knowledge of teachers in DKI Jakarta is different from the level of knowledge of the majority of teachers in other regions of Indonesia. This is understandable considering that Jakarta is the capital city of Indonesia with a better local government system than other regions.

Jakarta also allocates a larger amount of budget (28% of the APBD) for improving the quality of education in its region. The results of this study indicate that teachers with higher educational strata have higher PCK levels than teachers with lower educational strata. This fact can be a reference for improving the PCK of science teachers through efforts to encourage and facilitate teachers to continue their education at a higher level.

This study also resulted in the finding that teachers aged 4050 years had higher PCK rates, and began to decline after more than 50 years. This data can be used as input for the DKI Jakarta Education Office to create programs to increase teacher knowledge that are tiered, periodic, and sustainable. It is recommended that the development program for teachers who are over 50 years old be made more planned and varied to be effective. So that the knowledge of teachers remains high until they retire at the age of 60 years. The fact obtained from the results of this study is that teachers who work under 10 years have a higher PCK rate. The data shows that teachers who work for more than 10 years experience a decrease in the level of knowledge. Saturation is suspected as a factor causing this decline. Giving a variety of jobs and responsibilities that are more challenging to teachers is expected to be one solution so that teachers are more enthusiastic about increasing their knowledge. Giving rewards and punishments can also be one way to maintain and increase teacher knowledge.

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