Surveying In-service Teachers about Knowledge-Based Teacher, Engagement, and Expectation in Teacher Profession Education Program in Indonesia: Integrating Factor Analysis with Rasch Modeling

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**Abstract**. This paper reported the use of several quantitative analytic methods, including Rasch analysis, to examine teacher responses to questionnaire items probing opinions related to knowledge-based teacher, engagement, and expectation in Teacher Profession Education Program in Indonesia. While many reports have presented the impact of training-based teacher professional development program in Indonesia, the present paper improved on these outcomes by utilising Rasch analysis to identify items with orderly sequences of scores across response categories, and to subject these to fresh exploratory and confirmatory factor analysis. The resulting 3-factors (teacher knowledge, teacher engagement, teacher expectation) scale proved acceptable in terms of confirmatory factor analysis as well as in terms of Rasch item analysis. Furthermore, the paper briefly discussed the implications of these outcomes in relation to the refined instrument’s capacity to gather information about how teachers view and expectation about the Indonesian Teacher Profession Program, including gender disparity analysis.

1. Introduction

Over the past decade, there has been a dramatic increase in research on teacher professional development (TPD) program. Even today it has become a global agreement that teacher effectiveness has become the top of the education policy agenda criteria, because many countries have become convinced that teaching is one of the most important factors related to school especially in student achievement [1, 2]. In addition, teacher preparation and development are the key to developing effective teachers across the world [3]. For example, the State of Finland has strengthened a high quality education system that is equitable by establishing a quality teaching profession where all teachers hold at least a 2-year master's degree which includes mastery of strong subject matter content and mature pedagogical preparation, and is integrated in research and successful practice. The impact is that teaching has become the most sought after profession, and many teachers continue their studies to pursue PhD degrees and then remain teachers. In one generation, Finland jumped from relatively low-educated countries to the current literacy rate of 96%, with high graduation and college levels and top scores in all fields of PISA assessment [3,4,5]. Likewise with other great countries such as the United States, Britain, Australia, Canada, Singapura, and others, they already have a very massive teacher development professional development system and model [6,7,8,3].

 Furthermore, almost all countries in the world include teacher certification programs as one of the best efforts in teacher professional development programs. Many studies have tried to explain exploratively whether certification programs affect student achievement [9,10,11,12]. However, the general findings from the literature have not been very good. In addition, research that attempts to see the impact of teacher certification in developing countries on student performance is very rarely found in literature. One of the research result about quality teacher in Indonesia revealed that the teacher certification program in Indonesia has not seriously impacted the improvement of student learning outcomes, so TPD models are needed that are more effective in equipping teachers to be competent in all their professional duties [12]. In the context of preparing professional teachers in Indonesia, currently the teacher professional education program (PPG) has been implemented in the form of professional teacher learning to improve teacher knowledge and skills in supporting increasingly complex skills that students need to learn in preparation for further education and work in the 21st century. Sophisticated forms of teaching are needed to develop student competencies such as deep mastery of challenging content, critical thinking, complex problem solving, effective communication and collaboration, and self-direction. Thus, an effective teacher professional development model is needed to help teachers learn and refine the pedagogical knowledge and skills needed to teach these skills [13]. However, many studies show that the TPD initiative model that emerges is not effective in supporting changes in teacher learning practices and student learning outcomes. The causes are very diverse why the TPD implementation process is not successful including the implementation of TPD has not been based on an analysis of teacher needs, initial knowledge, the involvement of teachers in the previous TPD, and the teacher's expectations in developing himself as a professional teacher. While the entire domain of professional knowledge, professional practice and professional involvement, as well as the teacher's expectations about professional development greatly determine the success of the implementation of the teacher professional education program [14, 3, 15]. In addition, it is very important to understand the teacher's perspective on their teacher preparation program so that the TPD works well [16,17]. While [18] found a relationship between teacher perceptions of teacher preparation programs and their effectiveness as professional teachers. Furthermore, [18] notes that although a teacher's feelings for their preparation may not reflect their actual classroom practice, their preparation is highly correlated with teacher self-efficacy, which is also highly correlated with student achievement. The definition of results in teacher education programs and the ability to measure these correlations is very important to assist in the process of reform and policy making in teacher education [19]. This stage is even more important for the current education administration system that seeks to support their current teachers, beginning with understanding their preparation to play an active role in the overall professional development of teachers [20].

 This study examines the general set structure of the 30 items that we have developed. This survey involved 234 respondents as participants in the teacher professional education program at one of the state universities in the province of Lampung, Indonesia. This survey aims to examine whether the general items for the teacher preparation perception survey in this position function in an equivalent manner. This analysis provides an exploration of the constructs we made and ways to verify whether this construct is the same across groups of teacher categories such as age, length of teaching, gender, and teacher school graduates. But an exploratory in-depth analysis using Rasch models focuses on differences in gender views about the adequacy of teacher knowledge (content and pedagogy), teacher involvement in professional development, and teacher expectations for teacher development programs.

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1. Method

***Participants***

Characteristics of the participants are detailed in Table 1. Not all variables were collected for all participants, in part due to confidentiality concerns. Most the repsondents responding were young and graduate from a traditional teacher education program. Most of them responding had full-time involvement with the survey. Responses were received from 234 in-servive teachers who are participating in the TDP through teacher professional education programs in Indonesia.

Table 1. Description of the Samples

|  |  |
| --- | --- |
| Variable | Participants |
| Sex | n | % |
| Male |  49 | 20.94 |
| Female | 184 | 79.16 |
| Age |  |  |
| Mean | 42.98 |  |
| SD | 11.12 |  |
| Graduation |  |  |
| Public Teacher Education  | 154 |  |
| Private Teacher Education |  80 |  |
| Length of Teaching |  |  |
| Mean | 20.07 |  |
| SD | 11.10 |  |

***Instrument and Procedure***

The survey, as described above, was created via literature review and a comprehensive analysis of sources of standards for teacher preparation, to define three competency areas [21], with one additional area suggested by an advisory panel. Items were written by project personnel and vetted through teacher education program coordinator and a peer advisory professor. After modifications based on a series of cognitive interviews, the survey was approved by a panel of deans of colleges of education in the college. The body of the survey for teacher candidates was split into three sections, with each section eliciting views about an area of teaching competency, engagement in TPD, and expectation about TPD. In total, the survey of in-service teacher profession education contained 30 perceive items which reflected overall satisfaction with the program. The survey sent to in-service teacher students of TPD in Lampung University was divided into the same three competency areas. Then, participants response the survey through a google form online link.

***Analysis***The Rasch model [22] presents unidimensional constructs arranged in a regular pattern of increasing throughout the same interval. When data matches the Rasch model, estimates of materials and people are made by natural log transformation opportunities for raw data [23]. Rasch modeling is a broad collection of literature in the fields of education and social sciences [23,24]. The instruments examined through Rasch analysis allow us to determine the extent to which items function to consistently measure one variable from easy to difficult in a monotonically and regularly increasing mode. The Rasch model consists of a model family that applies to dichotomous, polytomous, and continuous data. The Rasch rating scale model was used in this study because responses were given on a 0-4 point rating scale, with the same step scale used for all items [25]. Rasch analysis allows researchers to evaluate the extent to which unidimensional scales are made by items in size. A rasch fit index is used to determine whether each item or person contributes to a single construct measurement by assessing the extent to which an item or person performs as expected. That is, with the right items that are quite difficult to be supported by fewer people than easy items. Likewise, respondents with less measured construction (for example, class management competencies) support fewer "difficult" items than respondents with more constructs measured. Fit mean square is modeled to 1.0 when the data matches the model. In addition, the analysis of the residual main components is used to determine whether the second factor seems to be present in the data. Furthermore, [26] suggests the instrument is likely to be unidimensional if the variance explained by the first dimension is substantial, the eigenvalue for the first contrast (analogous to the eigenvalue for the second factor in exploratory factor analysis) is less than or equal to 2.0, and the variance explained by the first contrast is less than 5%. Goods reliability index and people estimate the replicability of the placement of goods and orders of people. Separation of persona identifies the number of subgroups of people who can be discriminated against by the instrument. Separation and reliability of separation illustrates reliability in different ways [27]. The Rasch reliability index, along with Rasch estimates of item difficulties and people's abilities, is based on linear size rather than raw or ordinal data and is more suitable for subsequent parametric calculations of mean and standard deviation [28]. Finally, Differential Item Functional Analysis (DIFF) was used to conduct the analysis of the differences of each item response toward the differences of gender.

1. Result and Discussion

Based on the results of research conducted, the data obtained were analyzed using the Rasch Model using the Winstep 3.73 application. Winstepor checks the average score per item and response category [29]. The research instrument was tested on 234 PPG students. The research instrument is a scaled data that measures three aspects, namely the teacher's perception of his ability, activities to improve professionalism, and expectations for professional development. The instrument tested was 30 items, each aspect had 10 question items.

A research instrument that can be used correctly has good validity and reliability, the instrument can be accessed with indicators that will be achieved. The results of the analysis obtained that 30 reliable questions with Cronbach alpha value of 0.95 were included in the category of questions with very good reliability. Cronbach's alpha value to measure reliability is the interaction between the same person and item in Table 2 and Table 3.

Table 2. People's Reliability

-------------------------------------------------------------------------------

| TOTAL MODEL INFIT OUTFIT |

| SCORE COUNT MEASURE ERROR MNSQ ZSTD MNSQ ZSTD |

|-----------------------------------------------------------------------------|

| MEAN 59.5 30.0 -1.50 .38 |

| S.D. 13.6 .0 1.78 .21 |

| MAX. 101.0 30.0 2.41 1.83 |

| MIN. 30.0 30.0 -7.81 .28 .11 -6.1 .10 -5.8 |

|-----------------------------------------------------------------------------|

| REAL RMSE .47 TRUE SD 1.72 SEPARATION 3.65 Person RELIABILITY .93 |

|MODEL RMSE .44 TRUE SD 1.73 SEPARATION 3.96 Person RELIABILITY .94 |

| S.E. OF Person MEAN = .12 |

-------------------------------------------------------------------------------

Person RAW SCORE-TO-MEASURE CORRELATION = .96

CRONBACH ALPHA (KR-20) Person RAW SCORE "TEST" RELIABILITY = .95

Table 1 shows that the research instrument has a value of person reliability of 0.93 (Sumintono & Widhiarso, 2015), meaning that the instrument is in a very good category. This shows that the respondent answered the whole item earnestly and not carelessly.

Table 3. Reliability items

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| TOTAL MODEL INFIT OUTFIT |

| SCORE COUNT MEASURE ERROR MNSQ ZSTD MNSQ ZSTD |

|-----------------------------------------------------------------------------|

| MEAN 463.9 234.0 .00 .12 .99 -.2 1.00 -.1 |

| S.D. 42.3 .0 .63 .01 .27 2.6 .28 2.4 |

| MAX. 559.0 234.0 1.05 .13 1.58 5.2 1.68 6.0 |

| MIN. 398.0 234.0 -1.34 .11 .62 -4.2 .62 -3.8 |

|-----------------------------------------------------------------------------|

| REAL RMSE .13 TRUE SD .62 SEPARATION 4.75 Item RELIABILITY .96 |

|MODEL RMSE .12 TRUE SD .62 SEPARATION 4.99 Item RELIABILITY .96 |

| S.E. OF Item MEAN = .12 |

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Table 2 shows the value of item reliability of 0.96 included in the special category [30], meaning that all items identified have accuracy with the model and are quality items so that items this can be used to measure teacher perceptions of their abilities, activities to improve professionalism, and expectations for professional development.

In addition, good instruments are instruments that do not contain bias. The instrument is said to be biased when there is one individual with certain characteristics more advantageous than an individual with other characteristics. For example, instruments are more easily answered by male students than females, this indicates the existence of gender-biased items. Detection of the overall bias items can be seen in Table 4 and Figure 1.

Table 4. Differential Item Function (DIF)

---------------------------------------------------------------------------

| Person SUMMARY DIF BETWEEN-CLASS Item |

| CLASSES CHI-SQUARE D.F. PROB. MEAN-SQUARE t=ZSTD Number Name |

|-------------------------------------------------------------------------|

| 2 1.8941 1 .1687 .5933 .1326 1 K1 |

| 2 2.0556 1 .1517 .6394 .1776 2 K2 |

| 2 2.4292 1 .1191 .7648 .2900 3 K3 |

| 2 .0525 1 .8188 .0181 -1.0928 4 K4 |

| 2 .3597 1 .5487 .1180 -.6093 5 K5 |

| 2 .0249 1 .8745 .0120 -1.1640 6 K6 |

| 2 .0000 1 1.0000 .0007 -1.4651 7 K7 |

| 2 1.3681 1 .2421 .4365 -.0407 8 K8 |

| 2 7.0999 1 .0077 2.2936 1.1476 9 K9 |

| 2 .6324 1 .4265 .2052 -.3986 10 K10 |

| 2 .0574 1 .8106 .0206 -1.0687 11 K11 |

| 2 .3254 1 .5684 .0975 -.6734 12 K12 |

| 2 .9675 1 .3253 .3149 -.2066 13 K13 |

| 2 .1927 1 .6607 .0625 -.8079 14 K14 |

| 2 .0000 1 1.0000 .0011 -1.4302 15 K15 |

| 2 1.1637 1 .2807 .3726 -.1234 16 K16 |

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| Person SUMMARY DIF BETWEEN-CLASS Item |

| CLASSES CHI-SQUARE D.F. PROB. MEAN-SQUARE t=ZSTD Number Name |

|-------------------------------------------------------------------------|

| 2 .0383 1 .8448 .0172 -1.1028 17 K17 |

| 2 .3178 1 .5729 .1034 -.6543 18 K17 |

| 2 .5996 1 .4387 .1902 -.4300 19 K19 |

| 2 .1478 1 .7007 .0475 -.8816 20 K20 |

| 2 .5754 1 .4481 .1901 -.4302 21 K21 |

| 2 .1443 1 .7041 .0422 -.9114 22 K22 |

| 2 .2432 1 .6219 .0724 -.7659 23 K23 |

| 2 .0401 1 .8413 .0125 -1.1575 24 K24 |

| 2 .2254 1 .6350 .0667 -.7895 25 K25 |

| 2 .3725 1 .5417 .1121 -.6270 26 K26 |

| 2 2.7494 1 .0973 .8821 .3846 27 K27 |

| 2 2.9040 1 .0884 .9308 .4213 28 K28 |

| 2 .1096 1 .7406 .0365 -.9461 29 K29 |

| 2 1.5756 1 .2094 .5259 .0623 30 K30 |

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Table 3 shows that of the 30 instruments used in the study there was one instrument that contained gender bias, namely the K9 instrument with a probability value of 0.0077 (<0.05). This is in accordance with the statement [30]which reveals that a probability of more than 5% is considered to have no bias (difference).

Figure 1. Person DIF Plot

Figure 1 shows there are three curves based on the sex of the student, namely L (male), P (female), and \* (star) indicates the average value. From the graphic above, it can be seen in the K9 instrument that the ability of men to make learning media (including ICT-based) so that students can learn well, the knowledge L (Male) gained while studying was higher than that of P (Female).
To find out specifically about the existence and absence of item bias in each aspect, namely the teacher's perception of their abilities, activities to improve professionalism, and expectations for professional development can be seen in Table 5, Table 6, and Table 7.

Table 5. DIF Teachers' Perceptions of Their Capabilities

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| Person SUMMARY DIF BETWEEN-CLASS Item |

| CLASSES CHI-SQUARE D.F. PROB. MEAN-SQUARE t=ZSTD Number Name |

|-------------------------------------------------------------------------|

| 2 1.4788 1 .2240 .4643 -.0073 1 K1 |

| 2 1.7186 1 .1899 .5336 .0707 2 K2 |

| 2 2.1485 1 .1427 .6781 .2138 3 K3 |

| 2 .0799 1 .7774 .0261 -1.0206 4 K4 |

| 2 2.0099 1 .1563 .6469 .1847 5 K5 |

| 2 .7432 1 .3886 .2375 -.3362 6 K6 |

| 2 .3029 1 .5821 .0995 -.6671 7 K7 |

| 2 4.7052 1 .0301 1.5060 .7816 8 K8 |

| 2 8.7709 1 .0031 2.8505 1.3579 9 K9 |

| 2 2.8058 1 .0939 .9039 .4011 10 K10 |

---------------------------------------------------------------------------

Table 5 shows that there are two instruments that contain biases, namely the K8 and K9 instruments with probability values sequentially of 0.0301 and 0.0031, meaning that there are differences in abilities between men and women, in detail can be seen in Figure 2.

Figure 2. Person DIF Plot of Teacher's Perception of Their Cavability

Figure 3 shows that in the K8 instrument the ability of men to make good classroom action research, the research methodology L (male) obtained from college was lower than that of women. Instrument K9 shows that women's ability to make learning media (including ICT-based) so students can learn well the knowledge that P (Female) get is lower than that of L (male).

Table 6. DIF Activities to Improve Professionalism

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| Person SUMMARY DIF BETWEEN-CLASS Item |

| CLASSES CHI-SQUARE D.F. PROB. MEAN-SQUARE t=ZSTD Number Name |

|-------------------------------------------------------------------------|

| 2 .1636 1 .6859 .0505 -.8657 1 KP1 |

| 2 .5125 1 .4740 .1585 -.5018 2 KP2 |

| 2 1.0607 1 .3031 .3424 -.1659 3 KP3 |

| 2 .1487 1 .6998 .0481 -.8786 4 KP4 |

| 2 .0274 1 .8685 .0102 -1.1898 5 KP5 |

| 2 1.2212 1 .2691 .3941 -.0947 6 KP6 |

| 2 .0173 1 .8954 .0079 -1.2272 7 KP7 |

| 2 .5481 1 .4591 .1791 -.4543 8 KP8 |

| 2 .9706 1 .3245 .3103 -.2138 9 KP9 |

| 2 .1161 1 .7333 .0366 -.9459 10 KP10 |

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Table 6 shows that there is no gender difference in items that measure activities to improve professionalism because the probability value of all items is more than 5%.

Table 7. DIF expectations for professional development

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| Person SUMMARY DIF BETWEEN-CLASS Item |

| CLASSES CHI-SQUARE D.F. PROB. MEAN-SQUARE t=ZSTD Number Name |

|-------------------------------------------------------------------------|

| 2 .2314 1 .6305 .0734 -.7619 1 PP1 |

| 2 1.1631 1 .2808 .3436 -.1642 2 PP2 |

| 2 1.2209 1 .2692 .3553 -.1474 3 PP3 |

| 2 .4820 1 .4875 .1377 -.5546 4 PP4 |

| 2 1.0303 1 .3101 .2990 -.2314 5 PP5 |

| 2 1.4357 1 .2308 .4192 -.0624 6 PP6 |

| 2 2.3137 1 .1282 .7875 .3091 7 PP7 |

| 2 2.8435 1 .0917 .9197 .4130 8 PP8 |

| 2 .0049 1 .9440 .0028 -1.3501 9 PP9 |

| 2 .8871 1 .3463 .2784 -.2647 10 PP10 |

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Rasch Model analysis to measure aspects of teacher perceptions of their abilities, activities to improve professionalism, and expectations of professional development are used Mean Square values of Infit and Oufit as presented in Figure 4, Figure 5, and Figure 6.

Figure 4. Chart of Infit and Outfit measure per item Teacher's Perception of Their Capabilities

Figure 4, shows that the mean square fit values for infit and outfit per item all occupy a range of values from 0.5-1.7 where the item is not too difficult and not too easy [31,32]. The response category is based on the teacher's perception of his ability, there is no 100% who respond strongly or disagree. Based on the results of the study using Rasch Model analysis, in this study using confirmatory factor analysis that will optimize the results of the solution factors. Of the 10 items used to measure teacher perceptions of their abilities, it was found that all items had a high level of suitability based on the Rasch Model analysis.

Figure 5. Chart of Infit and Outfit measure per Activity Item to Improve Professionalism

Figure 5, shows that the mean square fit values for infit and outfit per item all occupy a range of values from 0.5 to 1.7 where the item is not too difficult and not too easy [31,32] Response categories are based on activities to improve professionalism, there are no 100% who respond strongly or disagree. The results of the study using Rasch Model analysis, where in this study using confirmatory factor analysis that will optimize the results of the solution factor. Of the 10 items used to measure activities to improve professionalism, it was found that all items had a high level of suitability based on the Rasch Model analysis.

Figure 6. Chart of Infit and Outfit measure per item of Expectation for Professional Development

Figure 6, shows that the mean square fit values ​​for infit and outfit per item all occupy a value range from 0.5-1.7 where the item is not too difficult and not too easy [31,32]. Response categories are based on expectations for developing professionalism, there is no 100% who respond strongly or disagree. Based on the results of the study using Rasch Model analysis, in this study using confirmatory factor analysis that will optimize the results of the solution factors. Of the 10 items used to measure expectations for developing professionalism, it was found that all items had a high level of suitability based on Rasch Model analysis.

Based on the research that has been done it is found that the data that has been analyzed using Rasch and confirmatory factor analysis has produced an instrument with a statistically and conceptually elegant factor structure, and can be used for teacher surveys. This is consistent with research conducted by [33] which states that the resulting factors proved acceptable in terms of exploratory factor analysis and confirmation and in terms of analysis of Rasch items so that teachers see the reporting system numerical Queensland.

1. Conclusion

The overall results of the Rasch model analysis on survey items on teacher perceptions in teacher professional education programs include three TDP attributes, namely the teacher's ability or teacher capability, activity or involvement in the TDP, and hopes for the implementation of TPD in teacher professional education, indicating that the survey instrument developed according to the quality of the instrument survey criteria with the validity and reliability of the items indicated by a consistent and consistent suitability with aspects of teacher's needs and perceptions in the teacher's professional education program. The higher significance of all factor items observed in the Rasch model analysis shows that instrument items can be used on a larger research scale to obtain a hypothetical model that is more complex than the teacher professional education development model. Important findings from this survey are still related to aspects of pedagogical content knowledge teachers (PCK) which require special emphasis in the TDP process through teacher professional education programs. In addition, there are still many teachers who feel lacking in mastering ICT, so most of them are not confident in developing ICT-based learning. PCK aspects of items. Furthermore, the analysis of gender differences using Differential Item Functioning (DIFF) shows that male teachers are better prepared for ICT than female teachers, but female teachers are superior in motivation to be actively involved in each TDP program. However, there was almost no significant difference between male teachers and female teachers about their perspectives on expectations in the TDP, all respondents wanted a more intensive and effective professional coaching process so that they achieved adequate competency.

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