Mathematics teacher knowledge in higher-order thinking skill: curriculum, pedagogy, and assessment

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Abstract. This study aims to investigate mathematics teachers’ knowledge of higher-order thinking skills as an evaluation for improvement, enhancement, and development. This research is quantitative research with a survey method involving 132 mathematics teachers in East Nusa Tenggara. They have completed the Professional Teacher Education at the University of Nusa Cendana in 2019. The instruments used are a curriculum knowledge questionnaire, pedagogy, and assessment consisting of 98 statements (36 curriculum knowledge, 28 pedagogical knowledge, and 24 assessment knowledge). The data analysis stage is categorizing the level of mathematics teacher knowledge using Likert’s Summated Rating, then analysis of correlation, regression, and Manova. Mathematics teacher's knowledge in higher-order thinking skills is at a high level of 34.1% (45 teachers) and a medium level with a value of 65.9% (87 teachers). The correlation value between the teacher's background and knowledge of higher-order thinking skills is in the low category with a very small coefficient of determination. Teaching level and gender show a significant influence on knowledge of higher-order thinking skills. Gender, age, and level of teaching have a significant effect partially on teacher knowledge; it also affects knowledge of higher-order thinking skills. However, the teaching level aspect did not significantly influence pedagogical knowledge.

1. Introduction
In the 21st century, the advancement of science and technology is rapid. Being successful in work, and likewise in life, people need to be equipped with special skills based on knowledge. Hence, all aspects of learning in school, focusing on competency outcomes, namely skills, knowledge, and expertise that must be mastered by students [1]. The learning output of mathematics learning is a problem-solving process that combines knowledge and thinking skills to solve situations that are unfamiliar, uncertain, and unfixed procedures. This process entails a dimension of thinking that includes adaptability and managing complexity and higher-order thinking [2]. Higher-order thinking skill is an important objective, and the need to enable the activities in education [3]. Higher-order thinking skill is the higher-levels of the hierarchy of cognitive processing [4]. It is reflected by the levels of Bloom's Taxonomy, which consisting of analysis, synthesis, and evaluation level. Higher-order thinking as the ability to think analytically, to think creatively, and to evaluate effectively [5][6]. Samo [7] revealed that higher-order thinking is a type of non-algorithmic thinking that includes analytic, evaluative, and creative thinking that implicate metacognition. This skill can be delineated as a situation when someone receives something as new information and then processing it with existing knowledge and produce information to solve a complicated problem [8]. Moreover, higher-order thinking skill is a thinking skill that uses
critical thinking and helps someone selects the best alternative by ordering, comparing, contrasting, evaluating, and selecting [9]. Students with higher-order thinking skills can decide what to believe, what to do, create a new idea, make a prediction, and solve a nonroutine problem [10]. Snyder [11] states that students who can think at a high level capable of solving problems by making effective decisions. Higher-order thinking skill emphasizes the significant role of the teacher. Students have to be equipped by a teacher with a holistic education that accentuates life skills, namely communication, critical thinking, cross-cultural, and collaboration [12]. Therefore, teachers attempt to evolve students' critical thinking skills or higher-order thinking skills by integrating them into their subjects [13]. Miri [14] suggests teachers purposely train higher-order thinking by delivering real-world problems, drive the open-ended discussions, and inquiry-oriented experiments in class. On the other hand, pre-service teachers are also advised to master higher-order thinking skills such as activity to analyze, then evaluate, and inference constitutes a valuable metal language [15]. It obviously indicate that how important the knowledge regarding higher-order thinking skill must be possessed by a teacher even a pre-service teacher. The importance of knowledge about higher-order thinking skills is the main requirement for the learning process to be implemented. The tendency of the conceptions of teachers and prospective teachers about higher-order thinking skills is related to differences in cognitive levels of questions and has not entered into other substances about learning to increase higher-order thinking skills. The limitations of the higher-order thinking skills conception related to questions are also interpreted incorrectly where higher-order thinking skills questions are understood as problems with long algorithms, word problems, difficult questions and problems at different material levels [6][16]. Another fact shows that teachers have difficulties in understanding higher-order thinking skills and PBL, likewise developing higher-order thinking skills based problems and teaching kits [17]. Retnawati [18] also found that teachers' knowledge about higher-order thinking skills is still low, especially in improving students' higher-order thinking skills and measuring students' higher-order thinking skills. This situation indicates that investigating a teacher's knowledge about higher-order thinking skills is needed.

Teacher's knowledge in higher-order thinking skills can be seen from three components such as curriculum, pedagogy, and assessment. These three components are the primary knowledge of a teacher to assist students in having critical thinking in the problem-solving process. This knowledge plays an essential role in achieving learning goals and education goals. Therefore, the exploration of this knowledge from the teacher can provide an evaluative description of improvement, development, and reflection. Abdullah [19] identified teacher knowledge in higher-order thinking skills, finding that the weakest aspect was the level of knowledge and practice of the assessment. Thus, this study aimed to describe teacher knowledge in higher-order thinking that focuses on components of curriculum, pedagogy, and assessment, which can be used for improving the quality of mathematics learning that leads to problem-solving skills.

2. Methods
This study is quantitative research with a survey method which aimed to analyze the level of knowledge of higher-order thinking skill (HOTS) among mathematics teachers. The focus of this study is the aspects of curriculum, pedagogy, and also assessment. It provides an overview to improve and develop the learning process. Two hundred four mathematics teachers in East Nusa Tenggara who completed Professional Teacher Education at the University of Nusa Cendana in 2019 involved as a population with 132 teachers as samples. The instrument used was a curriculum, pedagogy, and assessment questionnaire consisting of 98 statements with 36 items for curriculum knowledge, 28 items for pedagogical knowledge, and 24 items for assessment knowledge on a Likert scale. This instrument was developed by researchers based on an in-depth study of HOTS in Bloom's taxonomy, the characteristics of each cognitive level, curriculum 2013, and learning theory to improve HOTS and evaluation instruments to measure HOTS. Table 1 shows the lattices of an instrument of teacher knowledge in HOTS.
Table 1. The lattices of the instrument of teacher knowledge in higher-order thinking skills.

| Knowledge                                      | Indicator                                                                 | Description                                                                                                                                 |
|------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Level of Teachers' Knowledge in the Aspect of Curriculum | The conception of curriculum 2013 related to higher-order thinking skill and scientific approach | The comprehension of the scientific approach, the stage of the scientific approach, and scientific arguments to support higher-order thinking skill |
| Basic Competencies and Competencies Achievement Indicators according with curriculum 2013 | The comprehension of Basic Competencies and Competencies Achievement Indicators according, the connection between Basic Competencies and Competencies Achievement Indicators, and the position of indicator that supports higher-order thinking skill |
| Bloom's taxonomy                                  | The comprehension of the level of Bloom's taxonomy and the level description about higher-order thinking skill |
| Learning model                                    | The comprehension of the learning models contained in the curriculum 2013 and how the learning models support higher-order thinking skill |
| Level of Teachers' Knowledge in the Aspect of Pedagogy | Contextual learning and trending topic                                     | The comprehension about contextual learning as an approach which supports higher-order thinking skill                                       |
| Scientific questions                              | The comprehension about how to make an appropriate question to the cognitive level that enhances higher-order thinking skill |
| Utilization of nonroutine problems and novelty    | The comprehension about how to deliver nonroutine problems in different forms and level of thinking and teacher creativity in presenting problems |
| Utilization Scaffolding and metacognitive strategy | The comprehension of providing a proper assist when students work in a team to find a concept and solve a problem |
| Students strategy                                 | The comprehension about how to establish a student's higher-order thinking skill by encourages their argumentative and investigative attitude. |
| Technology integration                           | The comprehension of technology that supports higher-order thinking skill |
| Level of Teachers' Knowledge in the Aspect of Assessment | Level of Bloom's taxonomy question                                      | The comprehension about characteristic of question that fitted to higher-order thinking skill                                           |
| Category of assessment                            | The comprehension about categories of assessment and the instances to espouse higher-order thinking skill |
| Item test and Competencies Achievement Indicators | The comprehension of the precision of item test and competencies achievement indicators |

Data analysis be composed of 1) descriptive data analysis that describe teacher knowledge about three aspects, 2) categorizing teacher knowledge levels using Likert's Summated Rating, 3) correlation and
regression analysis between gender, age, training and development competencies experience, teaching experience, and the teaching level with higher-order thinking skill knowledge. The study utilizes simple linear regression analysis and linear regression with dummy variables, 4) manova analysis of the effect of the teacher's background on curriculum knowledge, pedagogy, and assessment.

3. Result and discussion

The questionnaire consists of several items, namely the respondent’s identity regarding name, gender, age, training and development competencies experience, teaching experience, and teaching levels. Profiles of respondents in this study are presented in table 2.

Table 2. Profile of respondents.

| Teacher Background | Category | F     | %   | Teacher Background | Category | f     | %   |
|--------------------|----------|-------|-----|--------------------|----------|-------|-----|
| Gender             | Male     | 69    | 52.272 | Training competencies | < 3 times | 74    | 56.060 |
|                    | Female   | 63    | 47.727 | 3-5 times | 45    | 34.090 |
| Age                | < 30 old | 29    | 21.969 | experience | 6-8 times | 5     | 3.787 |
|                    | 30-39 old| 87    | 65.909 | >8 times | 8    | 6.060 |
|                    | 40-49 old| 15    | 11.363 | Teaching | < 10 years | 86    | 65.151 |
|                    | >49 old  | 1     | 0.7575 | experience | 10-15 years | 30    | 22.727 |
| Level              | SMP/MTs (Junior High School) | 70    | 53.030 | 16-20 years | 12    | 9.090 |
|                    | SMA/SMK/MA (Senior High School) | 62    | 46.969 | >20 years | 4     | 3.030 |

Table 2 contains the findings out of data that the majority of teachers are young teachers under 40 years old, teaching experience under 10 years, training competencies experience under 8 years. This profile indicates that respondents are teachers who have the potential to develop themselves on the knowledge and teaching skills aspect. The data of the average score of teacher knowledge in HOTS regarding curriculum knowledge, pedagogy, and assessment consist of table 3.

Table 3 denotes that the average teacher knowledge in HOTS in the gender aspect is 3,375 for males and 3,175 for females. Based on the higher-order thinking skill knowledge component, the curriculum knowledge gained a score of 3.590 for males and 3.414 for females. Pedagogical knowledge scores 3,163 for males and 3,000 for females. Then a score of 3,372 for males and 3,112 for females respectively for the knowledge about assessment. Relatively, the acquisition of average scores of knowledge consistently high in curriculum knowledge, while the lowest is pedagogical knowledge for all scope of the teacher's background. The level of teacher knowledge in HOTS was obtained using the Summated Likert Ranking. The Respondent data categorized into five categories of knowledge, namely, very low, low, medium, high, and very high. It consists of 88 items, questions with the highest score were five, and the lowest was 1. The maximum score was 352, and a minimum was 88. The range in this data was 52. Furthermore, the categories and frequency of teacher knowledge in HOTS can be seen in table 4.

Table 4 shows the category of teacher knowledge in HOTS at a high level of 34.1% (45 teachers) and a moderate level with a value of 65.9% (87 teachers). Generally, the teacher's knowledge level of higher-order thinking skills lied at moderate and high category. It also applies to categorization based on the teacher background (age, gender, training competencies experience, teaching experience, and teaching level). Furthermore, we will see the statistical relationship between teacher background and Teacher knowledge in HOTS. The hypotheses are:
H₀ : there is no significant correlation between the teacher background and the teacher knowledge in HOTS.
H₁ : there is a significant correlation between the teacher background and the teacher knowledge in HOTS.

| Table 3. The acquisition of average scores of knowledge. |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Teacher Background      | Category           | Knowledge     |
|--------------------------|--------------------|----------------|----------------|-----------------|
| Gender                   |                    | Curriculum    | Pedagogy      | Assessment      | Total            |
| Male                     | 3.590              | 3.163         | 3.372         | 3.375           |
| Female                   | 3.414              | 3.000         | 3.112         | 3.175           |
| Age                      |                    |                |                |                 |
| < 30 old                 | 3.545              | 3.143         | 3.241         | 3.310           |
| 30-39 old                | 3.654              | 3.205         | 3.408         | 3.422           |
| 40-49 old                | 3.561              | 3.076         | 3.233         | 3.290           |
| >49 old                  | 3.056              | 2.679         | 2.917         | 2.884           |
| Training competencies    |                    |                |                |                 |
| < 3 times                | 3.615              | 3.198         | 3.381         | 3.398           |
| 3-5 times                | 3.649              | 3.195         | 3.386         | 3.410           |
| 6-8 times                | 3.472              | 2.964         | 3.142         | 3.193           |
| >8 times                 | 3.569              | 3.098         | 3.286         | 3.318           |
| Teaching experience      |                    |                |                |                 |
| < 10 years               | 3.663              | 3.186         | 3.381         | 3.410           |
| 10-15 years              | 3.663              | 3.200         | 3.382         | 3.415           |
| 16-20 years              | 3.632              | 3.134         | 3.333         | 3.366           |
| >20 years                | 3.722              | 3.143         | 3.375         | 3.413           |
| Level                    |                    |                |                |                 |
| SMP/MTs (Junior High School) | 3.548          | 3.099         | 3.300         | 3.316           |
| SMA/SMK/MA (Senior High School) | 3.438      | 3.044         | 3.135         | 3.206           |

| Table 4. Teacher’s knowledge level of HOTS. |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Category       | Score Interval | Frequency | Percent | Cumulative |
| Very low       | 88-158         | 0          | 0        | 0            |
| Low            | 159-229        | 0          | 0        | 0            |
| Moderate       | 230-298        | 87         | 65.9     | 65.9         |
| High           | 299-369        | 45         | 34.1     | 100          |
| Very High      | 370-440        | 0          | 0        | 100          |
| Total          | 132            | 100        |          |              |

The decision criteria are "if the statistical significance < probability 0.05, then H₀ is rejected and vice versa". A model of a statistical relationship between teacher background and teacher knowledge is entailed in table 5. Table 5 indicates the correlation value between variables, the coefficient of determination, the linear regression model, and the statistical decision H₀. On the whole, the correlation values between teacher background and knowledge in HOTS are in the low category with a very small coefficient of determination. It pointed out that the five items of teacher background made a very small contribution to teacher knowledge in HOTS. In testing the significance of the regression model, there was a significant effect of gender and teaching level on higher-order thinking skill knowledge. This confirms the truth that the correlation between the two variables on the teacher's knowledge of HOTS is greater than another teacher's background.
Generally, not all teacher background aspects have a significant effect on teacher knowledge in higher-order thinking skills. In this case, the effect of each aspect of HOTS will be sought out, namely curriculum knowledge, pedagogical knowledge, and assessment knowledge. The results of the analysis with Manova are presented in table 6.

| Effect | Value | F | Hypothesis df | Error df | Sig. | Noncent. Parameter | Observed Power |
|--------|-------|---|---------------|----------|-----|-------------------|----------------|
| Gender | Pillai's Trace | .273 | 16.014a | 3.000 | 128.00 .000 | 48.043 | 1.000 |
| | Wilks' Lambda | .727 | 16.014a | 3.000 | 128.00 .000 | 48.043 | 1.000 |
| | Hotelling's Trace | .375 | 16.014a | 3.000 | 128.00 .000 | 48.043 | 1.000 |
| | Roy's Largest Root | .375 | 16.014a | 3.000 | 128.00 .000 | 48.043 | 1.000 |
| Age | Pillai's Trace | .197 | 3.001 | 9.000 | 384.00 .002 | 27.006 | .971 |
| | Wilks' Lambda | .808 | 3.114 | 9.000 | 306.80 .001 | 22.550 | .932 |
| | Hotelling's Trace | .230 | 3.191 | 9.000 | 374.00 .001 | 28.723 | .980 |
| | Roy's Largest Root | .198 | 8.445c | 3.000 | 128.00 .000 | 25.335 | .992 |
| Training competencies experience | Pillai's Trace | .113 | 1.663 | 9.000 | 384.00 .096 | 14.963 | .767 |
| | Wilks' Lambda | .888 | 1.702 | 9.000 | 306.80 .088 | 12.368 | .663 |
| | Hotelling's Trace | .125 | 1.733 | 9.000 | 374.00 .080 | 15.593 | .787 |
| | Roy's Largest Root | .118 | 5.050c | 3.000 | 128.00 .002 | 15.150 | .911 |
| Teaching experience Level | Pillai's Trace | .020 | .287 | 9.000 | 384.00 .978 | 2.580 | .150 |
| | Wilks' Lambda | .980 | .284 | 9.000 | 306.80 .979 | 2.070 | .126 |
| | Hotelling's Trace | .020 | .282 | 9.000 | 374.00 .980 | 2.534 | .148 |
| | Roy's Largest Root | .017 | .741c | 3.000 | 128.00 .529 | 2.224 | .205 |

Data on table 6 shows the test results of each item of teacher background to all aspects of HOTS knowledge. The effect of each background on HOTS skill knowledge was analyzed by using four different tests with a significant value criterion <0.05. It can be concluded that there is an effect of teacher background on HOTS. The testing of gender, age, and teaching levels on HOTS knowledge based on the four tests show the significance value at 95% confidence level is less than 0.05. The gender aspect contributes to a significant effect on teacher knowledge in HOTS. Whereas, training competencies experience gives different results based on the four tests. The significance value > 0.05,
which means there is no effect of training competencies experience on teacher knowledge in HOTS. This condition is confirmed in the next Manova output table in table 7.

Table 7. Multivariate data analysis.

| Source          | Dependent Variable | Type III Sum of Squares | Df | Mean Square | F     | Sig. | Noncent. Parameter | Observed Power^4 |
|-----------------|--------------------|-------------------------|----|-------------|-------|------|--------------------|------------------|
| Gender          | Curriculum         | 1324.389                | 1  | 1324.389    | 13.344| .000 | 13.344             | .952             |
|                 | Pedagogy           | 681.575                 | 1  | 681.575     | 24.143| .000 | 24.143             | .998             |
|                 | Assessment         | 1277.820                | 1  | 1277.820    | 33.264| .000 | 33.264             | 1.000            |
| Age             | Curriculum         | 819.520                 | 3  | 273.173     | 3.149 | .027 | 9.446              | .720             |
|                 | Pedagogy           | 393.489                 | 3  | 131.163     | 6.364 | .000 | 19.091             | .964             |
|                 | Assessment         | 591.335                 | 3  | 197.112     | 4.881 | .003 | 14.644             | .901             |
| Training        | Curriculum         | 220.239                 | 3  | 73.413      | .799  | .497 | 2.396              | .219             |
| competencies    | Pedagogy           | 250.641                 | 3  | 83.547      | 3.868 | .011 | 11.603             | .814             |
| experience      | Assessment         | 194.093                 | 3  | 64.698      | 1.475 | .224 | 4.425              | .383             |
| Teaching        | Curriculum         | 32.950                  | 3  | 10.983      | .114  | .952 | .342               | .070             |
| experience      | Pedagogy           | 35.128                  | 3  | 11.709      | .531  | .662 | 1.594              | .156             |
|                 | Assessment         | 14.318                  | 3  | 4.773       | .099  | .961 | .296               | .067             |
| Level           | Curriculum         | 465.032                 | 1  | 465.032     | 4.286 | .040 | 4.286              | .538             |
|                 | Pedagogy           | 81.667                  | 1  | 81.667      | 2.307 | .131 | 2.307              | .326             |
|                 | Assessment         | 453.593                 | 1  | 453.593     | 9.580 | .002 | 9.580              | .867             |

Table 7 shows that gender, age, and teaching levels have a significant partial effect on teacher knowledge, as seen at the significance value <0.05. Therefore, it simultaneously affects the HOTS knowledge. However, the aspects of teaching levels do not affect pedagogical knowledge significantly, the significance value > 0.05. Other aspects, teacher background, training competencies experience, and teaching experience do not have a significant influence on teacher knowledge. It is because aspects of training competencies experience partially have a significant effect only on pedagogical knowledge and aspect of teaching level merely on curriculum knowledge.

This study reveals two things. First, the level of mathematics teacher knowledge in HOTS is based on three components, namely curriculum knowledge, pedagogy, and assessment. Second, the effect of the mathematics teacher's background on the knowledge of high order thinking skills based on curriculum knowledge, pedagogy, and assessment. Table 4 shows that the acquisition of average scores of knowledge is generally at a moderate and high level. The results indicate that teacher's knowledge in HOTS, their ability to improve students' HOTS, solve HOTS-based problems, and measure students' HOTS is still weak. There are facts that teachers have used various innovative learning models because they already understand the importance of HOTS [18]. Table 3 indicates that curriculum knowledge showed a high score than others. Furthermore, Shulman [20] defined the curriculum knowledge as knowledge aimed at teacher's reaching teaching materials and curriculums and using these resources most effectively. The teacher possesses this knowledge as an initial prerequisite for teaching because it contains curriculum conceptions, the focus of the curriculum, and the competencies that want to be evolved. Curriculum knowledge is addressed under two subcategories, knowledge aimed at students' purposes and targets which are required to be reached and knowledge aimed at concepts and materials included in the curriculum, peculiar to the subjects to be taught [21]. Furthermore, that curriculum knowledge includes the consciousness of various teaching materials, teaching procedures, and learning objectives [22]. The teacher knowledge in HOTS in the curriculum achieves a good category because HOTS conception in the curriculum is obvious indicated by the division of basic competencies in the curriculum, which included basic competencies of knowledge and skills. Skill basic competency is a
cognitive level of HOTS that can be accessed by the level of Bloom's taxonomy, namely, analysis, synthesis, and then evaluation. The lowest teacher knowledge is pedagogical knowledge. It includes knowledge regards the learning process to enhance HOTS, activity to practicing questions, the use of technology, and the use of nonroutine problems in the learning activity. Besides, teachers needed to have a deep understanding of mathematical knowledge, but it is not sufficient for them when teaching mathematics [23]. According to Tsafe [24] highlighted that pedagogy is the process of knowledge delivery to the learners by using techniques and strategies that will establish class understand the clear picture of the lesson. The teacher's failures to create the means to enrich the class is one of the reasons why the lesson of Mathematics is ever becoming a subject of discussion among students and consequently leads them to poor results whenever they sit for an exam that has to do with Mathematics. Pedagogy is not a theory but a practice. This argument allows the level of pedagogical knowledge to be lower than other components because the application of theory is not easy. Similar to the research findings by Retnawati [18], who revealed that the lowest knowledge of HOTS was assessment. The effect of the mathematics teacher's background on the knowledge in HOTS: curriculum knowledge, pedagogy, and assessment. The partial correlation coefficient between each background aspects and pedagogical knowledge is partially very low, which in turn influences the significance value of the regression model showed in table 5. Partially, there is no effect of age and knowledge. Training competencies experience and knowledge, and teaching experience with knowledge. Age, knowledge, and experience in various studies have a significant influence on teacher competency and teacher knowledge [25]. However, this condition is distinct from the results of this study, which showed no significant influence. The absence of this influence, according to the researchers, is because the teachers had merely just completed the Professional Teacher Education in the previous year; therefore, the knowledge in HOTS based on three components had sufficient retention. New knowledge is obtained when carrying out Professional Teacher Education, which is then implemented in the learning activity in each school so that it has the potential to reinforce existing knowledge applicatively. Further analysis using Manova in table 7 explains the results obtained in table 5. Gender aspects in the previous correlation and regression analysis revealed a significant effect of gender on teacher knowledge in HOTS. The finding supports this finding that gender partially affects all knowledge in HOTS, namely curriculum, pedagogy, and assessment. Furthermore, in the aspect of teaching levels, pedagogical knowledge is not significantly influenced by the teaching level. Two other aspects have a significant effect.

4. Conclusion
Mathematics Teacher knowledge in HOTS regarding curriculum, pedagogy, and assessment is a means of improving students' HOTS. Teacher with excellent knowledge in HOTS can assist students to extend their potential and thinking skill to adapt to the situation that tends to change. Teacher knowledge about HOTS at a high level of 34.1% (45 teachers) and a moderate level of 65.9% (87 teachers). It also applies to categorize based on the teacher background (age, gender, training competencies experience, teaching experience, and teaching level). The correlation values between teacher background and knowledge in HOTS are in the low category with a minimal coefficient of determination. It pointed out that the five-item of teacher background made a minimal contribution to teacher knowledge in HOTS. In testing the significance of the regression model, there was a significant effect of gender and teaching level on HOTS knowledge. The impact of each background on HOTS knowledge was analyzed by using four different tests with a substantial value criterion <0.05. It can be concluded that there is an effect of teacher background on HOTS knowledge. The testing of gender, age, and teaching levels on HOTS knowledge based on the four tests show the significance value at 95% confidence level is less than 0.05. The gender aspect contributes to a significant effect on teacher knowledge in HOTS.
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References
[1] Abdullah M and Osman K 2010 Procedia Soc. Behav. Sci. 9 1646–51
[2] Osman K, Hasan N and Hamid A 2009 Procedia Soc. Behav. Sci. 1 2573–77
[3] Zohar A, Dori Y J and Dori Y J 2009 J. Learn. Sci. 12 145–81
[4] Ramos J L S, Dolipas B B and Villamor B B 2019 Int. J. Innov. Interdiscip. Res. 4 47–60
[5] Pegg J 2001 Res. Conf. 35–8
[6] Thompson T 2008 Int. Electron. J. Math. Educ. 3 96–109
[7] Samo D D and Kartasasmita B 2017 Int. Educ. Stud. 10 17–29
[8] Yee M H, Yunos J, Othman W, Hassan R, Tee T K and Affyza M M 2015 Procedia - Soc. Behav. Sci. 204 143–52
[9] Raiyn J 2016 J. Educ. Pract. 7 115–21
[10] Lewis A, Smith D and Lewis A 2009 Theory into Pract. 32 37–41
[11] Snyder L G and Snyder M J 2008 Delta Pi Epsil. J. 2 90–100
[12] Teo P 2020 Learn. Cult. Soc. Interact. xxxx 1–15
[13] Cáceres M, Nussbaum M and Ortiz J 2020 Think. Sci. Creat. 37 100674
[14] Miri B, David B and Uri Z 2007 Res. Sci. Educ. 37 353–69
[15] Harrison N 2013 Australas. J. Educ. Technol. 29 54–65
[16] Samo D D 2017 Infin. J. Math. Educ. 6 121–36
[17] Jailani, Retnawati H 2016 Online J. Couns. Educ. 5 1–13
[18] Retnawati H, Djidu H, Apino E and Anazifa R D 2017 Probl. Educ. 21st CENTURY 76 215–30
[19] Abdullah A H 2017 EURASIA J. Math. Sci. Technol. Educ. 8223 3–17
[20] Shulman L S 1987 Harvard Educ. Rev. 57 1–21
[21] Basturk S and Donmez G 2011 Int. Online J. Educ. Sci. 3 743–75
[22] Niemelä M A and Tirir K 2018 Teachers’ Knowledge of Curriculum Integration: A Current Challenge for Finnish Subject Teachers, in Contemporary Pedagogies in Teacher Education and Development (London: IntechOpen)
[23] Ye S 2019 Procedia - Soc. Behav. Sci. 204 143–52
[24] Tsafe A K 2013 Sci. J. Pure Appl. Sci. 2 1–7
[25] Sciences H 2014 Int. Lett. Soc. Humanist. Sci. 19 140–47