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Evaluation of Teacher's Competencies and Its Effect on Mathematics Learning in 21st Century

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ABSTRACT

The era of the industrial revolution has consciously changed the perspective of education. Teachers are required to have high competence for producing students who can answer the challenges of the 4.0 era and equip students with 21st-century skills, namely the ability to think critically and solve problems. This study aims to describe the evaluation of teachers' competencies and their effect on mathematics learning in the 21st century. The approach of study is a quantitative descriptive approach. The population was all mathematics teachers at SMAN in Palopo. The total was 32 teachers. The sample selection was made by purposive sampling of as many as 15 teachers. Data collection techniques used a questionnaire. The data analysis technique used descriptive statistical analysis with percentages. The results showed that the pedagogic competence of mathematics subject teachers was a very good category with a percentage of 53%, personality competence was a very good category with a percentage of 93%, social competence was a good category with a percentage of 87%, and professional competence was a good category with 80% percentage. The evaluation of teachers' competencies was possible for teachers who have performance below of minimum standard to reflect and improve their performance so that it affects 21st-century mathematics learning, especially for teachers' competencies and student skills.

Keywords: Teacher's Competencies, Mathematics Learning, 21st century.

1. INTRODUCTION

Our current education is busy preparing a generation that can survive in the competition of the 4.0 industrial era because educational institutions are required to be able to have teachers who have high competence and have soft skills and can equip students with the skills needed in the 21st century [1]. The 21st-century competency learning objectives have become an essential topic of discussion around the world [2]. Many research findings reveal important reasons for focusing on 21st-century competencies.

The important skills in the 21st century are still relevant to the four pillars of life, which include learning to know, learning to do, learning to be, and learning to live together. Each of these four principles contains specific skills needed to be empowered in learning activities, such as critical thinking skills, problem-solving, and other skills [3].

According to Frydenberg & Andone, in the 21st century, everyone should have critical thinking skills, knowledge and capabilities of digital literacy, information literacy, media literacy, and mastering

information and communication technology [4]. Later, the US-based Apollo Education Group identified 10 skills needed to face the 21st century, i.e., critical thinking skills, communication, leadership, collaboration, adaptability, productivity and accountability, innovation, global citizenship, the ability to access, analyze, and synthesize information. This is in line with the Partnership for 21st Century Skills, emphasizing that 21st-century learning should teach 4 competencies, namely communication, collaboration, critical thinking, and creativity [5].

So based on some of these views, it is stated that critical thinking skills or abilities become a necessity and need to be developed for every individual who lives and competes in various aspects of the 21st century. Many studies concluded that mathematics has a potential role in developing critical thinking skills. In this regard, the mathematic teacher has a strategic role in helping their students to develop their critical thinking skills. Teachers should be able to provide opportunities for students to understand concepts and make justifications in the learning process, not just to learn that trains students to apply formulas and steps in mathematics subjects [6]; of

course, this phenomenon requires a medium and infrastructure to improve the quality of teacher's learning.

The development of competencies known as 21st-century skills is gaining a lot of attention as a medium to improve the quality of learning. However, the main challenge in realizing desired improvements is the lack of context-specific understanding of teaching practices and meaningful ways to support professional development [7]. Educators are expected to be able to manage to learn so that students have 21st-century competencies. This happens because a student's success depends on their 21st-century competence [8].

Competence in Bahasa Indonesia is an absorption word from English; competence means proficiency and ability. Competence is a collection of knowledge, behavior, and skills that a teacher must possess to achieve the learning and education goals [9].

Competency (Nessipbayeva, 2012) is essential to an educator's pursuit of excellence. Teachers need a wide range of competencies to face the complex challenges of today's world [10]. Furthermore, teacher competence is one factor that influences the achievement of learning and educational objectives in schools. Teacher competence is influenced by educational background factors, teaching experience, and length of teaching. Teacher competence is considered important as a selection tool in accepting prospective teachers and tracking teacher development. In addition, it is also essential concerning teaching and learning activities and student learning outcomes [11].

Furthermore, Law No. 14 on Teachers and Lecturers Chapter 1 of Article 10 explained that competence is a set of knowledge, skills, and behaviors that must be possessed, lived, and mastered by teachers or lecturers in carrying out professional duties [12].

The progress of education today cannot be separated from the role of teachers. *The central figures in the educational process (Nessipbayeva, 2012) are teachers. The success of training and education depends on their preparation, audition, and performance quality* [13]. Therefore, teachers must have competencies that are in accordance with national education standards. Based on the regulation of the Minister of National Education of the Republic of Indonesia Number 16 of 2007 concerning Academic Qualification Standards and Teacher Competencies, it is explained that teacher competency standards are developed as a whole from 4 main competencies, namely pedagogic, personality, social, and professional competencies [14]. These four competencies are holistic, meaning that teachers are not only required to have one or several of these competencies but teachers are required to have all these four competencies.

Hariato, a high school mathematics teacher in Palopo City, stated that teacher competence needs to be

evaluated and assessed periodically to determine the condition of teacher's performance or competence to improve if there is an unsatisfaction in their performance, especially for mathematics teachers in Palopo City. Research on teacher competence and performance is beneficial to maintain or strengthen teacher competence and performance and positively influences the learning process. Moreover, most students are so afraid of a mathematics teacher and think that mathematics is complicated so that students do not have the motivation to learn. Therefore, in addition to pedagogic and professional competencies that need to be developed, personality competencies and social competencies are two of the main avenues teachers need to cross to bring students closer to mathematics [15].

Based on the description above, the author is interested in discussing more deeply "Evaluating teacher competencies and their effects on mathematics learning in the 21st century" from the background of the existing problems, the authors then formulate several issues, including: (1) How is the competence of mathematics teachers in SMAN throughout Palopo City based on Academic Qualification and Teacher Competency Standards?; (2) What are the effects of teacher competence on mathematics learning in the 21st century?

2. LITERATURE REVIEW

2.1 Evaluation of Teacher's Competencies

2.1.1. Evaluation

The purpose of evaluation in the context of learning is to develop understanding carried out by educators. The learning evaluation objectives are learning activities that include teaching objectives, dynamic elements of education, implementation of learning, and curriculum [16].

In the evaluation of learning, several procedures must be followed to achieve the evaluation objectives. That starts from preparing a design containing the background of the review, problems, and the purpose of evaluation. Then data were collected by questionnaires, interviews, observations, and case studies. After data collection, data analysis was carried out individually, and in groups, then the last was the written out reports [17].

2.1.2. Teacher's Competencies

As one of the components in the learning process, the teacher plays a role in developing human resources business potential. In this framework, teachers teach as a transfer of knowledge process and as value transfer educators and mentors who guide along with students' learning process.

One of the requirements to become a teacher is to have competence. Competence is an ability that demands

responsibility and must be possessed as a professional teacher [18]. According to Law Number 14 concerning Teachers and Lecturers, Chapter 1 Article 10 explained that competence is a set of knowledge, skills, and behaviors that teachers or lecturers must possess, internalize, and control in carrying out their professional duties [20].

So based on the definitions above, it can be concluded that competence is an ability and responsibility that must be had as a professional teacher.

Professional teachers have a set of competencies (knowledge, skills, and behaviors) that must be possessed, internalized, and controlled by teachers in carrying out their professional duties. Competencies that teachers must own based on law number 14 years 2005 concerning teachers and lecturers in chapter IV Article 10 paragraph 91), which states that teacher competence includes pedagogic competence, personality competence, social competence, and professional competence obtained through professional education [21].

Pedagogic complexity is the ability to process students, which includes an understanding of learners [22], Personal competencies related to the readiness and willingness of teachers of various issues related to their duties and professions, Social competencies include the ability of teachers in multiple skills/behaviors, such as teaching skills, guiding, assessing, using teaching aids, associating or communicating with students, skills to maintain student's learning enthusiasm, skills to organize the preparation/teaching planning, skills to carry out administrative classes, and others [23] as well as professional competencies as the ability to master learning materials broadly and sincerely [24].

2.2 Mathematics Learning on 21st Century

Effective learning will achieve if the teacher reminds students of the material before the material is presented. Thus the learning objectives are expected to be completed. Teachers in the learning process of the industrial revolution 4.0 era act as facilitators and motivators. Teachers in learning resources use digital technology and online media as an effort to activate students. Teachers can connect teaching materials with students' real experiences so that students are helped in understanding learning materials [25].

Partnership for 21st Century Skills emphasizes that 21st-century learning should teach 4 competencies: communication, collaborative, critical thinking, and creativity. [26] In addition, the important skills of the 21st century that are very relevant to the orientation of learning in Indonesia are critical thinking and problem-solving. Critical thinking is a skill that students need to deal with the complexity and ambiguity of enormous information. Students need to be analytical thinking, comparing various conditions, and drawing conclusions to solve problems. This is important because, as developing countries still experiencing technological

euphoria, we need to prevent learners from misinformation, easily consumed hoax news, and lack of conscientious action. This can train the generation to be critical and conscientious from an early age. [27].

Few studies concluded that mathematics has a potential role in developing critical thinking skills. In this regard, the mathematic teacher has a potential role in developing their student's critical thinking skills. Teachers should provide opportunities for students to understand concepts and make justifications in the learning process, not just to learn that trains students to apply formulas and steps in math subjects. [28].

Mathematics is the most basic provision for students in improving the ability to think logically, critically, practically, systematically, analytically, and creatively. These six thinking abilities are essential components of 21st-century skills, namely critical thinking, creative thinking, communication, and collaboration [29]. Considering the skills needed in the 21st century, it is relevant to possess these competencies, especially in mathematics teachers as learning managers. These competencies are integrated into pedagogic competencies, personality competencies, social competencies, and professional competencies.

2.3 Teacher's Competency Indicators

Indicators of teacher's competencies in this study are pedagogic, personality, social, and professional competencies. The following table describes teacher competency indicators.

Table 1. Teacher's Competency Indicators

No.	Indicator	Sub Indicator
1	Pedagogic Competencies	a. Mastering understanding insight or educational foundation b. Mastering the understanding for students c. Curriculum Improvement d. Learning design e. Implementation of educational and dialogical learning f. Assessment and evaluation g. Student's potential development
2	Personality Competencies	a. Act according to religious norms (Steady, Stable, Mature, Wise, authoritative, and noble) b. Show an good personality model for students and the community c. Evaluate self-performance

		d. Develop themselves continuously
3	Social Competencies	a. Communicating spoken dan written b. Using communication and information technology functionally c. Associating effectively with students, fellow educators, educational staff, student's parents/guardians
4	Professional Competencies	a. Mastering concepts, structures, and scientific/technology/art methods that are coherent with teaching materials b. Mastering the teaching materials in the school curriculum/concept relationships between related subjects c. Implementing scientific concepts in daily life

3. RESEARCH METHOD

This study used a quantitative descriptive approach. The research population is all mathematics teachers at several high schools in Palopo, totaling 32 teachers. The sample selection was made by purposive sampling as many as 15 mathematics teachers with Civil Servants status. The following populations and samples in this study can be seen in the following table:

Table 2 Research Population

No	Name of School	Research Subjek
		Mathematics Teachers
1	SMA Negeri 1 Palopo	4
2	SMA Negeri 2 Palopo	3
3	SMA Negeri 3 Palopo	3
4	SMA Negeri 4 Palopo	2
5	SMA Negeri 5 Palopo	1
6	SMA Negeri 6 Palopo	2
Jumlah		15

Next, the data collection technique in this study is using a questionnaire. Data analysis techniques use descriptive statistical analysis with percentages.

4. RESULT AND DISCUSSION

The evaluation was conducted in controlling the quality of education nationally as a form of accountability of education providers. Evaluation is carried out on students, institutions, and educational

programs on formal and non-formal pathways for all levels, units, and types of education [30]. In this study, an evaluation was carried out to determine teachers' competence in high schools throughout Palopo City.

The indicators can be seen in Table 1. Teacher competency data were obtained from research questionnaires totaling 15 questionnaires given to 15 mathematics teachers, with 4 indicators and 27 statements. To describe the results of this study, a category of scoring scores was created. The research scores were grouped based on the percentage value obtained from Penilaian Acuan Norma (PAN) processing with scale [31]. The criteria are as follows:

$$Mi + 1,8 SDi \leq X \quad : \text{Excellent}$$

$$Mi + 0,6 SDi < X \leq Mi + 1,8 SDi \quad : \text{Good}$$

$$Mi - 0,6 SDi < X \leq Mi + 1,8 SDi \quad : \text{Average}$$

$$Mi - 1,8 SDi < X \leq Mi - 0,6 SDi \quad : \text{Poor}$$

$$X \leq Mi - 0,6 SDi \quad : \text{Terrible}$$

Teacher competence in mathematics learning is an ability shown by teachers in carrying out their duties or work as an educator in mathematics learning whose results can be used as a reference for developing teacher performance and as a further performance improvement consisting of 4 competencies, namely pedagogic, personality, social, and professional.

4.1 Pedagogic Competencies

The pedagogic competence of mathematics teachers can be categorized as very good because the majority gave a self-assessment in the very good category as many as 8 teachers (53%).

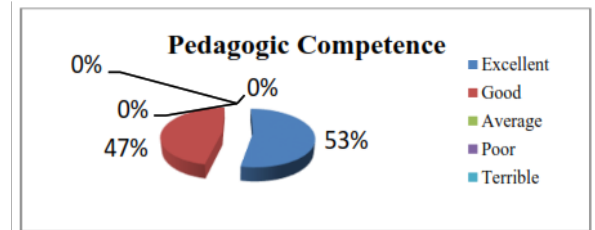


Figure 1 Diagram of Pedagogic Competencies

4.2 Personality Competencies

The personality competence of mathematics teachers can be categorized as very good because the majority gave a self-assessment in the very good category as many as 14 teachers (93%).

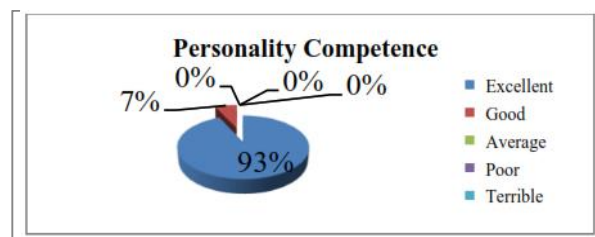


Figure 2 Diagram of Personality Competencies

4.3 Social Competencies

The social competence of mathematics teachers can be categorized as good because the majority gave self-assessment in the very good category as many as 13 teachers (87%).

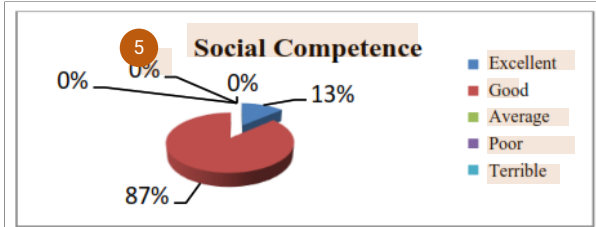


Figure 3 Diagram of Social Competencies

4.4 Professional Competencies

The professional competence of mathematics teachers can be categorized as good because the majority gave a self-assessment in the very good category as many as 12 teachers (80%).

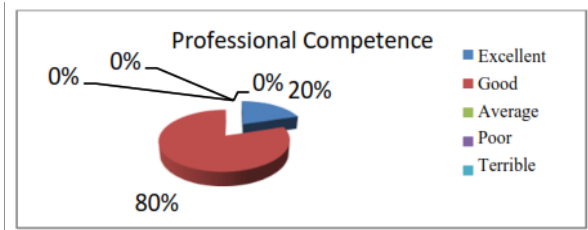


Figure 4 Diagram of Professional Competencies

4.5 Teacher's Competencies and its Effects on Mathematics Learning in the 21st Century

Conceptually, the development of mathematics teachers as professional staff must meet various competency requirements to carry out their duties and authority professionally. Professional competence is not only seen from certification. However, teachers who can face challenges in the current digital 4.0 era have professional competence, pedagogic competence, personality competence, and social competence [32]. So this certainly needs to be evaluated to affect learning as an improvement of quality of mathematics learning in the 21st century.

Arikunto revealed that evaluation is a series of activities aimed at measuring the success of educational programs. Based on the results of research related to 4 indicators of teacher competence, obtained the effects of teacher's competence evaluation in several high schools throughout Palopo City in 21st-century mathematics learning are as follows:

The results showed that the pedagogic competence of mathematics teachers at SMAN in Palopo City was in the very good category with a percentage of 53%. Pedagogic competence of mathematics teachers at SMANs throughout Palopo City will affect learning mathematics in the 21st century and improve students' achievement in

these schools. This is related to the results of research by Hawin et al. (2017), which suggests that the higher the pedagogic competence of teachers affected, the better mathematics learning achievement of students. The pedagogic competence of the teacher will encourage the creation of optimal learning activities and achievements because teachers who have good pedagogical competence constantly adjust their competence to the learning needs of students and be able to create a conducive, creative, effective, innovative and fun learning atmosphere so that they can develop their student's potential [34]. Furthermore, in their research, Ega et al. (2020) suggest that pedagogic competence improves students' critical thinking skills [35].

Then, most mathematics teachers at high schools in Palopo City are in the very good category with 93%, from various aspects related to personality competence. The personality competencies possessed by mathematics teachers at high schools throughout Palopo City will affect learning mathematics in the 21st century, developing teacher competencies and improving student achievement at school. This is in line with the research results conducted by Nilma and Mudjiran [36], who stated that personality competence is one of the four professional competencies that must possess by teachers. Teachers are required to explain learning materials to students and be responsible for increasing the potential and quality of students' personalities. To achieve this, teachers must have good personality competencies [36]. In addition, personality competencies are needed by teachers to deal with students during the mathematics learning process in the 21st century. These personality competencies will affect the quality of teachers in the learning process. This statement is supported by Roqib & Nurfua [37], which finds that personality competence significantly affects teacher quality. A teacher's personality competence is essential to provide guidance and role models, develop creativity, generate learning motivates, and encourage student progress [37].

Furthermore, most of the mathematics teachers at high schools in Palopo City are in the good category on social competence, social competence with a percentage of 87%, both for the development of teacher competence and improvements of student achievement in the school. The research results by Muhammad Febri, a postgraduate student at the State University of Medan [38] in the proceedings of a national seminar, stated that teachers' social competence had a positive and significant effect on students' mathematics learning achievement with an R2 value of 0.094 and Sig. 0.045. This social competence describes how teachers communicate through speaking and writing, use communication and information technology functionally, and interact effectively with students, fellow educators, educational staff, and parents/guardians. This certainly affected mathematics learning in the 21st century, emphasising the use of technology and students' critical thinking skills. This is in line with the research results by Aris et al. (highlighting

a positive influence in teacher-student communication on critical thinking skills of 57.17% [39].

The professional competence of mathematics subject teachers at high schools throughout Palopo City is in the good category with 80%. Regarding the study results, it was stated that professional competence is a competency that mathematics teachers must possess. This competency relates to the teacher's ability to develop teaching materials. This is in accordance with what is stated in the attachment of the Minister of National Education Number 16 of 2007 concerning Academic Qualification Standards and Teacher Competence Part B. Teachers as professional educators are expected to have the ability to develop teaching materials in accordance with existing mechanisms by taking into account the characteristics and social environment of students [40]. The use of teaching materials based on a scientific approach encourages students to think critically, analytically, and accurately in identifying, understanding, solving problems, and applying learning materials. Critical thinking is a directed and clear process used to solve problems, make decisions, persuade, analyze assumptions, and conduct scientific research. So that students' critical thinking skills become the main qualities to explore more knowledge gained [41].

Based on these perspectives, professional competencies need to be possessed by mathematics teachers to improve critical thinking skills in students as required in the 21st century today. This is in line with Sumarmo's statement (2013) that mathematics teachers should master their previous learning experiences, which are then equipped to be passed on to students, getting mathematical thinking processes, appropriate learning approaches, and methods so that they can support students to develop critical thinking skills effectively and efficiently, as well as improving a scientific attitude, discipline, responsibility, role model and self-confidence [42].

After an evaluation in the study specifically on teacher competence, it is expected to affect mathematics learning in the 21st century. Because basically, the function and purpose of learning evaluation are to develop the teaching process by educators. The competencies possessed by mathematics teachers will undoubtedly impact mathematics learning in the 21st century to develop teacher competence and the student's learning achievements and skills needed in the 21st century, such as communication, collaboration, critical thinking, and creativity.

5. CONCLUSION

The results showed that the pedagogic competence of mathematics teachers in high school throughout Palopo City was in the very good category with a percentage of 53%, personality competence was in the very good category with a percentage of 93%, social competence was in the good category with a percentage of 87%, social competence was in the good category with a percentage

of 87% and professionals competence are in the good category with a percentage of 80%.

By the evaluation and development of these 4 teacher competencies, it will have an impact on teacher's readiness for mathematics learning in the 21st century as well as preparing learning materials that provide 21st-century skills to students who are very much needed in learning mathematics, namely 4C skills, which include: 1) Communication, 2) Collaboration, 3) Critical thinking and Problem Solving, 4) Creativity and innovation.

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