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The Teacher Readiness Towards The Application of STEM Learning

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Abstract

This study aims to determine the level of readiness of teachers towards the application of STEM learning (Science, Technology, Engineering, Mathematics) survey in kindergarten teachers in Gunungpati district, Semarang City. In addition, this study also aims to determine the supporting and inhibiting factors in the application of STEM learning in kindergarten teacher in the Gunungpati District area of Semarang City. The method is a quantitative descriptive research method with a survey design based on Singarimbun & Effendi theory. The data collection techniques using a questionnaire or questionnaire in the form of a Likert scale. The population is 116 teachers. The research sample used the Purposive Cluster Sampling design with a total sample of 25% of the total population and then fulfilled to 30 teachers. The results of the questionnaire data are collected from the whole teacher then processed and categorized based on a range of percentages. The results of the analysis of the data related to attitude and emotional readiness or Emotive-Ettitudinal Readiness, Cognitive Readiness, Behavioral Readiness. This readiness is also influenced by supporting factors such as being aware of strengths and shortcomings, adaptation, and enthusiasm. While the inhibiting factors are low cognitive knowledge and critical thinking in learning activities, perceptions, and understanding of STEM concepts that are still low and lack of discussion with other teachers and lack of cooperation with partners who are more experienced in STEM learning. In outline, this study can be concluded that teacher readiness for the application of learning STEM (Science, Technology, Engineering, Mathematics) survey in kindergarten teachers in the Gunungpati District of Semarang City has Emotive-Ettitudinal Readiness by 70% in the category of agreed or ready, Cognitive Readiness is 69.33% in the agreed or ready category, and Behavioral Readiness is 65.11% in the neutral category. This means that the readiness of teachers towards the application of learning STEM (Science, Technology, Engineering, Mathematics) in kindergarten teachers in Gunungpati District Semarang City is 68.27% in the agreed or ready category.

How to Cite

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INTRODUCTION

Education is a learning activity in all matters both academic and non-academic to develop the potential of students. The essence of education itself is clearly stated in Law Number 20 the Year 2003 concerning the National Education System, in chapter 1 article 1 that:

"Education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential to have spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, nation, and country."

Education has shifted from time to time following the times. We are now in a century where all individuals can access information and communication without limits. The century is called the 21st century. Entering the 21st century requires each individual to have skills both soft skills and hard skills that are ready to face global competition and compete with other countries. According to Trilling, B. & Fadel, C. (2009) that:

"The core subject and interdisciplinary 21st century themes are surrounded by three sets of skills most in demand in the 21st century: (i)learning and innovation skills, (ii) information media and technology skills, (iii) life and career skills".

Education graduates are required to master 21st-century skills to be able to face the competition. One of the right ways to prepare individuals to face intense competition is by having these skills through education. The current quality of education continues to be developed in various aspects such as teacher quality, material development, methods used, improvement of the facilities, and improvement in the learning quality. The aspects developed must be in harmony with the competition with the skills that are formed. According to (Susiana, 2014) in National Seminar of Education that:

"Based on analysis and synthesis from 20 literatures such as Curriculum 21, Essential education for a changing world, 21st century skills: learning for live in our times, Assessment and teaching of 21st century skills, Guided inquiry, Learning in the 21st century, Creativity for 21st century skills; how to embed creativity into the curriculum, 21st century skills, rethingking how students learn".

In that fact, education must be renewed (Charles Handy in Rose & Nicholl (2009: 16). Education must be addressed right from the beginning, especially starting in early childhood education. According to Umaroh (2013) in (Andikawati & Diana, 2017) early childhood is the most unique and sensitive. Another opinion, according to (Peter K, Simideleola T, & Patience, 2019) childhood is the initial stage of laying the foundation for children's welfare and learning in the future. That is the most critical time for child growth and development.

In recent years, to face global challenges, especially in the field of education, there is the latest learning breakthrough, namely learning STEM (Science, Technology, Engineering, and Mathematics). STEM is an acronym for professional study or practice in the broad fields of science, technology, engineering, and mathematics (Jarayah, Saat, & Rauf, 2014). According to Early Childhood STEM Working Group (2017), early childhood education and STEM education are both at the forefront in education discussions in the realm of policy and media recently. The early years of childhood as an important thing to lay the foundation for future learning in STEM with suggestions that can be done by teachers involving children in STEM activities that utilize children's prior experiences, knowledge, and interests (NRC) in (Champbell, Speldewinde, Howwit, & MacDonald, 2018).

Apart from STEM must be prepared and as a habit of generation in problem-solving to welcome future challenges, the role of the teacher in learning activities is the key to achieving student learning goals. According to (Ulfa & Waluyo, 2016) the success of educational goals in schools depends on existing human resources such as school principals, teachers, students, and other education personnel. According to Slameto (2010: 113) readiness is the condition of someone who makes him ready to give a response/answer in a certain way towards the situation. The teacher is the key to effective learning success. According to (Nurani, Pratiwi, & Kusumaningtyas, 2018) teachers must also master basic skills in teaching, because basic skills can provide a deeper understanding of teaching, especially, for teachers in the 21st century.

21st-century teachers are required not only to be able to teach and manage classroom activities effectively but also to be able to build effective relationships with students and the school community, use technology to support the improvement of teaching quality, as well as reflect and continuously improve their learning practices (Darling, 2006 in (Andriani, 2010). Teachers with 21st-century skills can be obtained by mastering the STEM-based approach. In Indonesia, education with the STEM learning model has been applied at several levels of education but on a

very small scale. Entering STEM education must be prepared thoroughly especially for teachers as stated in the Early Childhood STEM Working Group (2017) that:

"For all children to have access to high-quality STEM experiences preschool, their teachers need to be well-prepared in both content and pedagogy to lead high-quality STEM experiences in their classrooms".

According to (Mariyana, Handini, & Akbar, 2019) various learning approaches can be taken to make a change. Considering the changes in education with the latest learning there is STEM in the Semarang City area there are several levels of education. Published news on (pauddikmasjateng.kemendikbud, 2018) explains that 21st-century skills that must be possessed by students at the global level, one of which is the STEAM learning approach and one of the early childhood education institutions in the Semarang City area has applied STEM in STEAM focus learning activities, that is PAUD/TK Aksara.

Based on the description above, the last few years the STEM approach has developed in Semarang City and the lack of information related to teacher readiness for the application of STEM learning. Therefore, the researcher is interested in exploring the readiness of teachers to apply STEM learning in one area, which is the Gunungpati district of Semarang city. From the description that has been described above, the researcher will describe "Teacher Readiness toward Application of STEM Learning (Science, Technology, Engineering, Mathematics) (Survey on Kindergarten Teachers in Gunungpati District, Semarang City)".

The researcher's focus in conducting this research is related to the readiness of the teacher with the parts of readiness (readiness of attitudes and emotions or emotive-attitudinal readiness, cognitive readiness, and or behavioral readiness related to STEM learning and find the supporting and inhibiting factors which can influence the application of STEM learning based on the theory of Bandura et al (Maddox, dkk, 2000, p.27) in (Wangid, Mustadi, Erviana, & Arifin, 2014) explains readiness consists of three parts, as follows:

"(a) Emotive-Ettitudinal Readiness or readiness for attitudes and emotions consists of : (1) emotional readiness is assumed to be the responsibility for carrying out a task; (2) enthusiasm for a task, (3) willingness to adapt to a task at any time, (4) comfort and independence in carrying out a task, and (5) appreciate the intrinsic value in a task, (b) Cognitive Readiness consists of : (1) possesses critical cognitive and thinking skills that are important for performing their duties, (2) aware of strengths and shortcomings, (3) has made a connection between tasks performed with reality on the ground, (4) aware of self-worth and a willingness to carrying out tasks, and (5) able to integrate concepts and tools from various scientific disciplines, (c) Behavioral Readiness or readiness of behavior consists of : (1) willing to carry out partnership functions with their colleagues in work and facilitators, and (2) adept at managing time to achieve goals that are in accordance with their duties."

This study aims to determine how much the level of teacher readiness for the application of learning STEM (Science, Technology, Engineering, Mathematics) and determine the supporting and inhibiting factors of the application of STEM learning (Science, Technology, Engineering, Mathematics) (kindergarten teacher survey in Gunungpati District Semarang City). The advantage of this research is to discuss and provide information and descriptions of the level of teacher readiness for the application of STEM learning (Science, Technology, Engineering, and Mathematics) in Kindergarten Teachers in Gunungpati District, Semarang City.

METHOD

According to Sugiyono (2016: 7), the quantitative method is called the positivistic method because it is based on the philosophy of positivism. This study used a quantitative descriptive survey design method based on Singarimbun & Effendi (2008: 3) theory. The research data is collected by questionnaire or questionnaire data collection techniques on a Likert scale.

The population in this study is kindergarten teachers in Gunungpati Subdistrict, Semarang City. The population of kindergarten teachers is 116 people. The sample is part or representative of the population studied in Arikunto (2002: 109). If the number of respondents is less than 100, all samples are taken so that the research is population research. Whereas if the number of respondents is more than 100, then sampling is 15% or 20% -25% or more in Arikunto (2002: 112). The research sample uses the Purposive Cluster Sampling design by taking a sample of 25% of the total teacher population randomly without specifying the characteristics of the teacher to be sample i.e as many as 30 teachers. The study is conducted on August 5, 2019 - August 16, 2019.

The data analysis technique which is used in this research is percentage technique. Purwanto (2008, p.29) states that respondents' answer sco-

re is obtained through following formula: (Score of expected score)/(Expected score)×100%. The percentage result is then categorized into 5 categories as follows:

Table 1. Descriptive Percentage Category

Interval	Category
84%- 100%	Very agree
68%-83%	Agree
52%-67%	Neutral
36%-51%	Not Agree
16%-35%	Very Not Agree

RESULTS AND DISCUSSION

Attitude and Emotional or Emotive-Attitudinal Readiness Readiness

The results of research on the readiness of teachers on aspects of attitudes and emotions towards the application of STEM learning in kindergarten teachers in the Gunungpati District of Semarang City are as Table 2.

Based on Table 2, it is known that of the 30 teachers as research samples, 63.33% or 19 teachers in the agreed or ready category; 33.33% or 10 teachers stated neutral; 3.33% or 1 teacher stated that they did not agree or are not ready with an average of 70%, the teachers are said they agreed or are ready.

Cognitive Readiness

The results of research on teacher readiness on cognitive aspects of the application of STEM learning in kindergarten teachers in Gunungpati Subdistrict, Semarang City are as Table 3.

Based on Table 3 that is presented above, it is known that of the 30 teachers as research samples, 3.33% or 1 teacher in the category strongly agreed or very prepared; 53.33% or 16 teachers in the agreed or ready category; 43.33% or 13 teachers in the neutral category with an average of 69.33%, the teacher stated agreed or ready.

Behavioral Readiness

The results of research on the readiness of teachers on behavioral aspects of the application of STEM learning in kindergarten teachers in the Gunungpati District area of Semarang City are as Table 4.

Based on Table 4 which is presented above, it is known that of the 30 teachers as research samples, 33.33% or 10 teachers in the category agreed or ready; 60% or 18 teachers in the Neutral category or quite ready; 6.67% or 2 teachers in the neutral category with an average of 65.11%, the teacher stated neutral.

Table 2. The Distribution of Emotive-Attitudinal Readiness Aspect

No	Interval (%)	Category	Frequency	Percentage
1	84%-100%	Very agree	0	0,00%
2	68%-83%	Agree	19	63,33%
3	52%-67%	Neutral	10	33,33%
4	36%-51%	Not Agree	1	3,33%
5	16%-35%	Very Not Agree	0	0,00%
Total			30	100%
Average			70,00%	
Category			Agree	

Table 3. The Distribution of Cognitive Readiness Aspects

No	Interval (%)	Category	Frequency	Percentage
1	84%-100%	Very Agree	1	3,33%
2	68%-83%	Agree	16	53,33%
3	52%-67%	Neutral	13	43,33%
4	36%-51%	Not Agree	0	0,00%
5	16%-35%	Very Not Agree	0	0,00%
Total			30	100%
Average			69,33%	
Category			Agree	

Data calculations from each aspect have been explained. The following conclusions from the overall results of the calculation of percentage data aspects of readiness Table 5.

From the results of the overall calculation of the aspect of readiness, it can be concluded that the readiness of attitudes and emotions or Emotive-Ettitudinal Readiness by 70% in the category of agreed or ready, Cognitive Readiness by 69.33% in the category of agreed or ready, Behavioral Readiness in neutral category with an average of all aspects of preparedness of 68.27% in the agreed or ready category.

Sub Indicators of Emotive-Attitudinal Readiness

According to Bandura et al (Maddox, et al, 2000, p.27) explains the aspects of Emotive-Attitudinal Readiness consist of 5 indicators. In detail, the Emotive-Ettitudinal Readiness indicators are illustrated in Table 6.

Based on Table 6 which is presented above, it is known that the five indicators of Emotive-Ettitudinal Readiness are responsibility with a percentage of 71.83% in the agreed or ready category; enthusiasm indicator with a percentage of 75.50% in the agreed or ready category; adaptation indicator is 77.17% in the agreed or ready category; indicator appreciates intrinsic value in a task with a percentage of 63.83% in the neutral category.

Sub Indicators of cognitive readiness or Cognitive Readiness

According to Bandura et al (Maddox, et al, 2000, p.27), explaining this aspect of Cognitive Readiness consists of 5 indicators. In detail, the Cognitive Readiness indicators are illustrated in Table 7.

Based on Table 7 that is presented above, it is known that five indicators of Cognitive Readiness are indicators of cognitive skills and critical thinking with a percentage of 64.83% in the neutral category; a indicator of strengths and shortcomings aware by percentage of 78.00% in the agreed or ready category; an indicator of the relationship between tasks and facts in the field with a percentage of 68.42% in the agreed or ready category; an indicator of self-awareness and willingness with a percentage of 66.34% in the

Table 4. The Distribution of Cognitive Behavioral Readiness Aspect

No	Interval (%)	Category	Frequency	Percentage
1	84%-100%	Very agree	0	0,00%
2	68%-83%	Agree	10	33,33%
3	52%-67%	Neutral	18	60%
4	36%-51%	Not Agree	2	6,67%
5	16%-35%	Very Not Agree	0	0%
Total			30	100%
Average			65,11%	
Category			Neutral	

Table 5. The Result of the Average of Readiness

Readiness Aspect	Percentage	Category
Emotive-Ettitudienal Readiness	70,00%	Agree
Cognitive Readiness	69,33%	Agree
Behavioral Readiness	65,11%	Neutral
Average	68,27%	Agree

Table 6. The Distribution of Sub Indicator of Emotive-Attitudinal Readiness Aspect

Indicator	Percentage	Category
1. Responsibilities	71,83%	Agree
2. Enthusiasm	75,50%	Agree
3. Adaptation	77,17%	Agree
4. Comfort and Independence	72,84%	Agree
5. Appreciate intrinsic value in a task	63,83%	Agree

Table 7. The Distribution of Sub Indicator of Cognitive Readiness Aspect

Indicator	Percentage	Category
1. Cognitive Skills and Critical Thinking	64,83%	Neutral
2. Aware of Strengths and Weaknesses	78,00%	Agree
3. Relationship Between Tasks and Facts on the Field	68,42%	Agree
4. Aware of Self-Value and Will	66,34%	Neutral
5. Integration of concepts and indicators Tools of various scientific disciplines renewal	68,67%	Agree

neutral category; indicator of integration of concepts and tools of various scientific disciplines of renewal with a percentage of 68.67% in the agreed or ready category.

Sub Indicator of Behavioral Readiness

According to Bandura et al (Maddox, et al, 2000, p.27), explaining this aspect of Behavioral Readiness consists of 2 indicators. In detail, the Behavioral Readiness indicators are illustrated through Table 8.

Table 8. The Distribution of Sub Indicator of Behavioral Readiness Aspect

Indicator	Percentage	Category
1. Partnership Function	66,11%	Neutral
2. Time Management	66,22%	Neutral

Based on Table 8 which is presented above, it is known that the two Behavioral Readiness indicators is an indicator of partnership function with a percentage of 66.11% in the neutral category; and time management indicators with a percentage of 66.22% in the neutral category.

Teacher Readiness Level toward the Application of STEM Learning (Science, Technology, Engineering, Mathematics)

Teacher quality is the most important factor associated with schools with student achievement (RANDS Corporation, 2012). Teacher readiness to teach has special elements, including knowledge, attitudes, and interests which are important components that directly contribute to the creation of effectiveness and establish teaching methods (Jusoh, 2012; Lang, 1992 in (Park, Dimitrov, Patterson, & Park, 2017). Teachers' readiness to implement STEM learning must be prepared, especially teachers in early childhood education.

More and more research shows that early STEM experiences (defined as preschool for three classes) play an important role in increasing the knowledge, skills, and dispositions of children needed for future work and preparing students for future work and preparing students for complex problems (Aronin and Floyd, 2013; Chesloff, 2013; DeJarnette, 2012; New, 1999 in (Park, Dimitrov, Patterson, & Park, 2017). For example (Chesloff, 2013) Teachers' readiness to implement STEM learning must be prepared, especially teachers in early childhood education.

More and more research shows that early STEM experiences (defined as preschool for three classes) play an important role in increasing the knowledge, skills, and dispositions of children needed for future work and preparing students for future work and preparing students for complex problems (Aronin and Floyd, 2013; Chesloff, 2013; DeJarnette, 2012; New, 1999 in (Park, Dimitrov, Patterson, & Park, 2017). For example (Chesloff, 2013) argues that STEM must start in early childhood because of the concept at the heart of STEM-curiosity, creativity, collaboration a demand.

Kindergarten teacher readiness in Gunungpati Subdistrict on the application of STEM learning is explained by the theory according to Bandura et al (Maddox, et al. 2000, p.27) that there are three parts of readiness, they are readiness for attitudes and emotions or emotive-attitudinal readiness, cognitive readiness, and behavioral readiness. Readiness of attitudes and emotions or emotive-attitudinal readiness is known that responsibility bears all risks and strives in the application of STEM learning, enthusiasm, and enthusiasm in the application of STEM learning seeks to adapt to adaptation in the application of STEM learning, comfortable and thoughtful self-development in the application of STEM learning, and know and understand the basic concepts of STEM learning. Attitude and emotional readiness or emotive-attitudinal readiness by 70% the category agreed or ready.

Second, teacher readiness is seen from cognitive readiness or cognitive readiness. The opinion of (Morisson & Fletcher, 2002)"The concept of cognitive readiness may be of special relevance and significance for those who must adapt quick-

ly to rapidly emerging, unforeseen challenges". Cognitive skills in critical thinking understand STEM learning, recognize self-abilities related to the application of STEM learning, the relationship between tasks and reality in the application of STEM learning, and the ability of teachers to integrate STEM concepts and existing infrastructure in the field that supports the STEM learning process. Cognitive readiness or cognitive readiness is 69.33% in the agreed or ready category.

Third, teacher readiness is seen from the readiness of behavior or behavioral readiness is also measured to implement STEM learning. Opinion (La Paro & Pianta, 2001) "Behavioral readiness includes the capacity to approach learning tasks effectively, with focused interest and sustained engagement, and it involves the capacity to relate positively to peers and teachers, with cooperative initiative and appropriate aggression control". Behavior readiness in this study as well as training and self-development related to the application of STEM learning and time management in the preparation of STEM learning. Behavioral readiness is in 65.11% neutral category.

Supporting factors

According to (Sneideman, 2013) STEM is a way of thinking about how educators at all levels including parents must help students integrate knowledge across disciplines, encouraging them to think in more connected and holistic ways. The change in education at this time requires the readiness of the self by educators to support these changes with their abilities. Supporting factors are known from the aspects and indicators of readiness that have the results of calculation of data on sub-indicators with the highest percentage, they are (1) aspects of cognitive readiness/ indicators of strength and lack of awareness of 78%, (2) aspects of emotive-attitudinal readiness/ adaptation indicators of 77, 17%, and (3) emotive-attitudinal readiness/indicator of enthusiasm by 75.50%.

These three indicators are said to be supporting factors in teacher readiness for the application of STEM learning. It is known that teachers in the Gunungpati District area are aware of their strengths and lack of ability to face the application of STEM learning in the future, in line with research (Smith, Douglas, & Cox, 2009) "More supportive and engaging learning environments can help us accomplish our most important outcomes for STEM graduates: stronger thinking and reasoning skills, problem formulation and problem-solving skills, skills for working together cooperatively with others, and, especially, skills and confidence for figuring things out in complex environments and situations". Second, teachers must be ready to adapt to changes in education with STEM learning, such as opinions (Charles Handy in Rose & Nicholl (2009: 16) education must be renewed, and finally, enthusiasm, shows that the teacher's sense of enthusiasm and enthusiasm is quite high towards self-readiness in application of STEM learning.

Inhibiting Factors

Changes in education resulted in various changes in various fields, especially education. This phenomenon is very important for teachers to prepare themselves to face changes in education. But to achieve these goals certainly have obstacles or problems that interfere with the education process. Inhibiting factors seen from the theory Bandura et al (Maddox, et al, 2000, p.27) aspects of the aspects and indicators of readiness that has the results of calculation of data on the theory sub-indicators with the lowest percentage, they are (1) aspects of Emotive-Attitudinal Readiness/Indicators appreciate the value intrinsic in a task of 63.83%, (2) aspects of cognitive readiness/indicators of cognitive skills and critical thinking by 64.83%, (3) aspects of behavioral readiness/indicators of partnership functions by 66.11%.

These three indicators are said to be a limiting factor in teacher readiness for the application of STEM learning. It is known that teachers in the Gunungpati District area appreciate intrinsic values in an assignment, meaning the ability to recognize and animate the basic concepts of STEM learning for teachers is the lowest. This finding is in line with previous research (Wahono, Bevo and Chang, Chun-Yen, 2019), "There are some factors potentially influencing the condition, growth, and subtainability of STEM education. The factors include: gender, educational experience, perception, area of specialization, etc". Second, the low cognitive ability and critical thinking in implementing STEM learning, this finding is in line with previous research (Ramli, et al., 2017) "Teachers' readiness in implementing STEM education is still at a low level. There are an internal constraint such as teachers' self-confidence and few external constraints such as insufficient reference materials and poor infrastructure facilities". Dan ketiga, kurangnya guru membangun diskusi dengan guru lain dan kurangnya bekerja sama dengan pihak yang berpengalaman di bidang pembelajaran STEM sama halnya menurut And thirdly, the lack of teachers builds discussions with other teachers and the lack of col-

laboration with experienced parties in the STEM learning field as according to (Brown J, Brown T, & Readon K, et al, 2011) suggests the need for collaboration in schools about STEM education when teachers are trained outside their content area about issues related to STEM learning.

CONCLUSION

Based on the results of research conducted in Gunungpati district about teacher readiness for the application of STEM learning (Science, Technology, Engineering, Mathematics), it can be concluded that the percentage of teacher readiness for the application of STEM learning is based on aspects of the researcher's attention, Emotive-Ettitudinal Readiness aspect are aspects which has the largest percentage of 70%, while the cognitive aspect of 69.33% and the aspect of behavioral readiness of 65.11%. The overall percentage of all three aspects is included in the agreed or ready category that is equal to 68.27%. This means that the teacher's readiness level for the application of STEM learning (Science, Technology, Engineering, Mathematics) is 68.27% or in the agreed or ready category. Supporting and inhibiting factors in teacher readiness for the application of STEM learning are (a) Supporting factors include conscious power and deficiency; enthusiasm; and adaptation (b) The inhibiting factors are the low cognitive knowledge and critical thinking in learning activities, the low perception, and understanding of STEM concepts and the lack of discussion with other teachers and lack of cooperation with partners who are more experienced in STEM learning.

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