KARYA ILHAM PUBLISHING
CONNECTING MINDS, BRIDGING IDEAS, INSPIRING READERS

International Journal of Advance Research in Future Ready Learning and Education

Journal homepage:
https://karyailham.com.my/index.php/frle/index
ISSN: 2821 - 2800

Enhancing Teachers' Mathematical Pedagogy: Implementing the Learning Curriculum with a Scientific Approach at Junior High Schools

Murni[1,*], Manovri Yeni[2], Musliadi Usman[3], Anzora[1], Risy Mawardati[4]

1	Mathematics Education, Faculty of Teacher Training and Education, Universitas Abulyatama, Aceh Besar, Aceh, Indonesia
2	Civil Engineering, Faculty of Engineering, Universitas Muhammadiyah Aceh, Banda Aceh, Aceh, Indonesia
3	The Asian Development for Education and Research Studies, Aceh, Indonesia
4	Mathematics Education, Faculty of Teacher Training and Education, Universitas Iskandar Muda, Aceh Besar, Aceh, Indonesia

ARTICLE INFO

Article history:
Received 15 March 2025
Received in revised form 15 April 2025
Accepted 30 May 2025
Available online 20 June 2025

Keywords:
Teacher understanding; the independent curriculum; scientific approach; mathematics

ABSTRACT

Scientific learning activities will proceed effectively when teachers understand what a scientific approach entails. Therefore, the research focuses on how mathematics teachers comprehend and implement scientific approaches. This study employs qualitative research methods, with the subjects being mathematics teachers from ten schools across Aceh Besar Regency. Data analysis is conducted using a qualitative descriptive approach. The results indicate that Junior High School Mathematics Teachers in Aceh Besar Regency are capable of developing learning tools that align with the scientific approach prescribed by the independent learning curriculum. Teachers have implemented a scientific approach in mathematics instruction, following discussions among themselves to refine their teaching strategies. The competence of mathematics teachers in Aceh Besar Regency in applying a scientific approach to teaching is considered good, influenced by various factors. These include their educational background, scientific knowledge, teaching experience, workload, participation in training, proficiency in teaching methods and media, reading habits, and overall work ethic. These elements collectively shape their understanding and positive response to the implementation of the scientific approach in mathematics instruction.

1. Introduction

The independent learning curriculum or called the independent curriculum applies freedom of thought and independence for all students. The educational program "independent Curriculum" provides new insights that education is not only focused on cognitive assessment, but also affective and psychomotor assessment of students [1]. Self-learning can be interpreted as the application of the curriculum in the learning process that demands pleasure with the development of innovative and creative thinking by teachers where the essence of freedom of thought must start from teachers as drivers of national education. The independent learning curriculum forces teachers to change their

* *Corresponding author.*
E-mail address: murni_fkip@abulyatama.ac.id

https://doi.org/10.37934/frle.39.1.117

approach and learning strategies. A teacher must be able to change the approach to learning according to the challenges of the times. A teacher is required to be able to update their competencies in accordance with the independent learning curriculum [2].

Soft skill development in higher education is still challenging. Today work performance influences many changes in knowledge, skills, and attitudes that may contribute to satisfying successful performance [3]. The teacher is an educator who is a major factor in the creation of the nation's next generation. In accordance with RI Regulation No. 19 of 2005 concerning National Education Standards, "The quality of education is said to be of high quality if the learning process in educational units is carried out interactively, inspirationally, fun, challenging, and motivates students to excel actively and provide sufficient space for movement [4]. For initiative, creativity, and independence in accordance with the talents, interests, and physical and spiritual development of students, therefore teachers as the frontline in the world of education play a role in educating the nation's generation. Based on Law Number 20 of 2003 Article 39 concerning the National Education System states that educators are professionals who are in charge of planning and implementing the learning process, evaluating learning outcomes, conducting mentoring and training, and conducting research and community service, especially for educators in universities [5].

1.1 The Role of Teacher

The role of teachers extends beyond delivering subject matter; they act as facilitators, mentors, and motivators in the learning process. In mathematics instruction using a scientific approach, teachers guide students through inquiry-based learning, encourage critical thinking, and foster problem-solving skills. They structure lessons effectively, select appropriate teaching methods, and integrate various media to enhance understanding. Additionally, teachers continuously improve their competencies through professional development, collaboration, and self-directed learning. Their ability to adapt, inspire, and create an engaging learning environment significantly impacts student success and overall educational quality.

Teachers are The most important components at Teaching and learning processes that play a role at attempt Creating people who Superior, intellectually intelligent and Spiritual [6] (Sufairoh, 2016). With the idea of Freedom to learn to be a form of improving the quality of Indonesian education, then Compulsory Teacher carry out its duties with full of responsibility. As a result of educational purposes can good walk in accordance with what that aspired to. To make this happen, the teacher must have Competence at Himself that summarized at pedagogic competence, personality competence, social competence and professional competence. To welcome the Merdeka Belajar curriculum, teacher at least Must have Four competencies that everything have function and gait each according to Annisa Alfath et al., [7]. Without competence, a teacher Like somebody Skipper in the middle of the ocean No expertise that Adequate while in front of him, high waves are ready to topple the ship [7]. Therefore, to become a teacher, it is mandatory to meet the qualifications of a teacher. Article 10 of Law of the Republic of Indonesia Number 14 of 2005 concerning Teachers and Lecturers, which is then regulated in the Regulation of the Minister of National Education Number 16 of 2007 concerning Academic Qualification Standards and Teacher Competencies [13], there are four competencies that teachers need to have, namely pedagogic competence, personality competence, social competence and professional competence [15].

The learning model is the basis of learning and learning theory by Alirahman et al., [8]. Some of the model that must be mastered by a teacher are pedagogic competencies that is ability Master Master Learning and Control classes with good Include understanding of learners, design and applications Learning Output assessment learn and Student Development by Wijayanti [9]. Teachers

must have Competence to carry out educational learning and dialogical. Because No communication that well, then none education that well anyway. Assignment Primary Teacher on Learning is communicating the environment so that Supporting Change kondite and formation of competence of learners. Related personality competencies use Figure appearance The teacher becomes a person who has discipline, good looking, responsibility, have commitment and as example. Reflected personality competencies at personality that stable, mature, wise, authoritative and charismatic. Related personality competencies use Figure appearance The teacher becomes a person who has discipline, good looking, responsibility, have commitment and as example. Reflected personality competencies at personality that stable, mature, wise, authoritative, and Karimah [10].

Personality that owned a teacher is Foundation Primary for self-embodiment Become a Teacher Who effective good at carry out their professional duties at Educational Environment also community. It has meaning that a teacher must be able to Realize Exclusive ones effective in order to be able to carry out functions and His responsibilities become a teacher. For that teacher Mandatory know himself and can Developing the realization exclusive healthy, intelligent and humane. Related social competencies use ability Teachers become social creatures at Interact use others [11].

By Social competence lies deep communication. Communication can interpreted become a mutual process Hypnotize escort person. Without communication then one cannot socialize. However, communication that Referred to has the meaning of communication that effective. Communication Often be an expression of feelings or asa yang want to be delivered well in a way personal or Non Personalgood that done consciously or not aware. Reasons why social competence must Owned a teacher especially during the implementation of the independent learning curriculum, namely: deep Fact People are social creatures that requires each other to run the wheel of life. Moreover, teachers have assignment become coaches, figures, role models, officers and social change agents of society. So that Teachers are key Crucial to Interaction Activities school deep community [12].

1.2 The Importance of Soft Skills Development

Soft skills are essential for students' overall development, complementing academic knowledge with abilities like communication, critical thinking, and teamwork. In mathematics learning with a scientific approach, these skills help students analyze problems, collaborate, and express ideas effectively. Teachers play a key role in fostering soft skills, creating a supportive environment that prepares students for real-world challenges. Professional competence of the relevant teacher uses Broad mastery of learning materials and Deep which includes: Mastery of the subject matter at school, mastery of structure and its scientific methodology. From the description at above can it is known that professional competence be Competence what is required Owned and Controlled Lecturer on His main task. So that a teacher Required to master science that Related to the field of study [14].

In the independent learning system, teachers should master all competencies that are considered capable of carrying out the learning process with a good scientific approach in accordance with the demands of the Independent Curriculum. The ability of teachers to master the competence of scientific approaches in the independent curriculum is very influential on student learning outcomes. The ability of teachers to present mathematical material with interesting learning will affect student learning outcomes and increase student learning creativity in mathematics lessons. The scientific approach consists of five stages or learning experiences, namely observing, questioning, trying,

collecting information, associating/ reasoning, and communicating, and can be continued with the stages of creating.

The scientific approach is applied to facilitate learners in building knowledge (Mahmudi, 2015). That knowledge can be facts, concepts, or procedures. In addition, scientific approaches have the potential to develop students' creativity. Teachers should consistently apply this scientific approach in learning practices in accordance with the characteristics of the subject [13]. Learning using a scientific approach is a learning process that is designed in such a way that students actively construct concepts, rules or principles through the stages of observing (to identify or find problems), formulating problems, proposing or formulating hypotheses, collecting data using many techniques, analyzing data, drawing conclusions and communicating concepts, rules or principles that are "discovered" [6]. This competency is expected to improve teachers' ability to prepare scientific learning with a better independent learning curriculum to meet the challenges of the times.

1.3 Scope of Study

This study focuses on the implementation of a scientific approach in mathematics instruction at junior high schools in Aceh Besar Regency. It examines teachers' ability to structure lessons, their understanding of the approach, and the factors influencing their competence. The study also explores the role of collaboration among teachers and the impact of teaching experience on their ability to apply the approach effectively.

1.4 Delimitation of Study

This research is limited to junior high school mathematics teachers in Aceh Besar Regency and does not include teachers from other educational levels or regions. It primarily assesses the scientific approach in mathematics instruction without analyzing other teaching methodologies. Additionally, the study relies on observations and teacher discussions, excluding direct assessments of student learning outcomes.

1.5 Problem Statement

The implementation of a scientific approach in mathematics instruction is essential for enhancing students' critical thinking, problem-solving skills, and engagement in learning. However, challenges arise in its practical application, particularly in junior high schools in Aceh Besar Regency. Teachers often rely on imitation rather than a deep understanding of the methodology, lacking a clear rationale for selecting instructional steps and operational verbs. Additionally, while collaboration among teachers plays a role in shaping their teaching strategies, the extent to which it enhances their competencies remains uncertain. Furthermore, various factors such as educational background, teaching experience, training participation, and work ethic influence teachers' effectiveness in applying the scientific approach. This study seeks to analyze these challenges, assess the competency levels of mathematics teachers, and identify key areas for improvement to optimize the implementation of the scientific approach in mathematics education.

1.6 Research Question

This study aims to examine the implementation of the scientific approach in classroom teaching across the junior high schools in Aceh Besar, based on the independent curriculum. The discussion addresses three key questions:

i. Do teachers understand the Scientific Approach as prescribed by the independent curriculum for mathematics learning in junior high schools?
ii. How do junior high school teachers in Aceh Besar apply the Scientific Approach within the framework of the independent curriculum?
iii. Are teachers able to overcome the obstacles encountered when teaching mathematics using a scientific approach and the independent curriculum at Junior High School (SMP) Aceh Besar?

2. Research Method

The methodology used in this study is a qualitative research method. Qualitative research is well-suited for investigating real classroom situations and the learning process because it allows for an in-depth exploration of teacher behaviors, experiences, and instructional strategies. Unlike quantitative methods, which focus on numerical data, qualitative research provides rich, descriptive insights into how teachers implement the scientific approach in mathematics instruction. Through observations, interviews, and discussions, this method captures the complexities of teacher decision-making, the challenges they face, and the contextual factors influencing their teaching practices. Additionally, qualitative research enables a deeper understanding of teacher collaboration, professional development, and the reasoning behind instructional choices, making it an effective approach for analyzing the nuances of educational practices in real classroom settings.

This study employed purposive sampling to select 10 mathematics teachers from junior high schools in Aceh Besar Regency. The selection was based on specific criteria, including teaching experience, familiarity with the scientific approach, and willingness to participate in the study. Teachers were chosen to ensure a diverse range of perspectives, considering factors such as years of service, educational background, and prior training in scientific learning methods.

While the sample provides valuable insights into the implementation of the scientific approach, it may not be fully representative of all mathematics teachers in the region. Potential biases could arise due to the limited sample size and the selection of teachers who may already have some familiarity with the approach. However, the purposive sampling method ensures that the study captures rich, in-depth data from teachers directly involved in applying the scientific approach in their classrooms.

The research is conducted based on real classroom situations, considering the context and learning process. The subjects of this study were mathematics teachers from ten junior high schools (SMP) located in various areas of Aceh Besar Regency. Data collection was carried out using four methods: observation, interviews, field notes, and documentation. Interviews were recorded using a recording device. Data collection involved three stages of the learning process: pre-teaching interviews, learning observations, and post-teaching interviews. Data analysis was performed using three main sources: 1) written transcripts of recorded pre-teaching and post-teaching interviews, as well as transcriptions of in-class teaching; 2) observations and notes by researchers; and 3) teaching documents.

2.1 Study Context

The study was conducted in junior high schools located in Aceh Besar Regency, which includes a mix of both urban and rural schools. These schools serve a diverse student population, with varying socio-economic backgrounds. Rural schools tend to have limited resources and infrastructure, which can affect both teaching and learning processes. In contrast, urban schools may have better access to educational materials and professional development opportunities. These contextual factors influence how the scientific approach is implemented in the classroom and contribute to the diversity of teaching practices observed in the study. By considering the characteristics of both rural and urban schools, the findings offer a comprehensive view of the challenges and opportunities faced by mathematics teachers in different settings.

2.2 Data Collection Procedures

The data collection process involved multiple methods to capture a well-rounded view of the implementation of the scientific approach;

i. Classroom Observations
   A total of two classroom observations were conducted for each teacher. Each observation session lasted 45–60 minutes, allowing the researcher to observe a full lesson cycle. The observations focused on the teacher's use of the scientific approach, including the application of inquiry-based activities, student engagement, and the integration of critical thinking in the lesson.
ii. Interviews
   Semi-structured interviews were conducted with the 10 mathematics teachers after the classroom observations. These interviews allowed for flexibility, enabling the researcher to explore specific topics in more detail while ensuring that key questions related to the teachers' experiences with the scientific approach were addressed. The questions were designed to elicit both descriptive and reflective responses regarding the teachers' teaching methods, challenges faced, and perceptions of the scientific approach.
iii. Documentation Analysis
   Various types of documentation were analyzed to gain insights into the teachers' planning and instructional practices. This included lesson plans that outlined the scientific approach's implementation, as well as teaching materials such as worksheets, multimedia resources, and other classroom tools used to support the learning process. Analyzing these materials helped to understand how teachers designed and structured their lessons, and whether their practices aligned with the scientific approach's key principles.

3. Result and Discussion

3.1 Does the Teacher Understand the Scientific Approach in Accordance with the Independent Curriculum in Mathematics Learning in Junior High School?

To answer this problem, researchers conduct interviews before the teaching process. Learning Implementation Plan (LP) is an estimate or prediction of what actions are taken while carrying out learning activities. In addition, researchers also checked the suitability of LPs used for teaching. LP describes the learning procedure to achieve one basic competency set out in the content standard and has been stated in the syllabus. There are goals and benefits of making LP, namely to provide the main foundation for teachers and students in achieving the basic competencies and indicators to provide an overview of short-term work references. LP, which involves systematic planning, has an

influence on the development of individual students, because it is carefully planned before learning. LP preparation is very important and must be carried out by teachers before carrying out the Teaching and Learning Process because LP is clarified about instructional objectives, material planning, planning tools, steps, and learning procedures to achieve these goals. However, in its implementation in the field, there are still teachers who have not fully carried out the process of making LPs before carrying out the learning and teaching process. Table 1 shows a teacher LP with scientific approach while Table 2 meaning by code used.

Table 1
Teacher LP with a scientific approach to Junior High Schools in Aceh Besar Regency

School	Teacher's Name	Material	Scientific Approach Lesson Plan				
			M1	M2	M3	M4	M5
SMP A	Teacher A1	Cube surface area	Dstt	Dstt	Dstt	Dstt	Dstt
	Teacher A2	Area of a circle	Dst	Dstt	Dstt	Dstt	Dstt
SMP B	Teacher B1	Rows and rows	T	Dtd	Dstt	T	Dstt
	Teacher B2	Pythagorean theorem	Dstt	Dst	Dstt	Dstt	Dstt
SMP C	Teacher C1	Social arithmetic	Dstt	Dstt	Dstt	Dstt	Dstt
	Teacher C2	Stastistik	Dst	Dst	Dstt	Dstt	Dstt
SMP D	Teacher D2	Angle recognition	Dst	Dst	Dstt	Dstt	Dstt
	Teacher D1	Surface area of cubes and blocks	Dstt	Dstt	Dstt	Dstt	Dstt
SMP E	Teacher E1	Circle	T	T	Dtd	Dtd	Dtd
	Teacher E2	Profit percentage and loss percentage	G	G	Dstt	Dstt	Dstt
SMP F	Teacher F1	Social arithmetic	Dstt	Dstt	Dstt	Dstt	Dstt
	Teacher F2	Chance	Dst	Dst	Dstt	Dstt	Dstt
SMP G	Teacher G1	Root form and rank	T	T	Dstt	Dstt	Dstt
	Teacher G2	Social arithmetic	Dst	Dst	Dst	Dstt	Dstt
SMP H	Teacher H1	Social arithmetic	Dst	Dtd	Dstt	Dstt	Dstt
	Teacher H2	comparison	G	Dst	Dstt	Dstt	Dstt
SMP I	Teacher I	Social arithmetic	Dtd	Dtd	Dstt	Dstt	Dstt
SMP J	Teacher J1	central angle of circumference angle	Dstt	Dstt	Dstt	Dstt	Dstt
	Teacher J2	Profit percentage and loss percentage	T	Dst	Dstt	Dstt	Dstt

Table 2
Code used

Code used	Means
M1	Observe
M2	Inquired
M3	Collecting information
M4	Reasoning/associating
M5	Communicate
Dstt	Designed in writing
Dst	Designed implicitly
Dtd	Just called but not designed
T	Not designed
G	Failed to design

The results showed based on Table 1 that SMP A, A1 teachers can design scientific approaches in lesson plan (LP). This means that the five steps of the scientific approach are explained in detail in the LP, while A2 teachers have not been able to design the five steps of the scientific approach in the LP. One step is not designed in writing but only implied design, that is, the observing step. A2 teachers said that the observation steps were only written in the LP without giving an explanation, because A2 teachers still did not understand the steps to observe scientific approaches. So further learning is needed for a scientific approach.

SMP B, B2 teachers apply an independent curriculum with a scientific approach, while B1 teachers have not used it. But there are two similar steps designed with a scientific approach: gathering information and communicating. While the steps of observing and associating / reasoning are not designed and the steps of questioning are only mentioned without being designed in the LP. Because B1 teachers have not studied the scientific approach in detail. So B1 teachers have not been able to plan LPs with a scientific approach. B2 teachers have applied teaching with a scientific approach and B2 teachers have designed a scientific approach in LP. But there is one step that has not been designed in writing, namely the question step which is only written down without explanation. Teacher B2 said because he still did not understand what things should be designed at that step.

SMP C, both teachers have applied a scientific approach in learning. C1 teachers can design the five steps of the scientific approach in the LP, the five steps are designed in writing. While C2 teachers only design four steps in writing scientific approaches in the LP. One step is not designed in writing, only implicitly that it is *an observing step*. According to the C2 teacher, the observing step is not yet fully understood.

SMP D, D1 teachers and D2 teachers have implemented an independent curriculum with a scientific approach. D1 teachers plan the five steps of the scientific approach in writing in the LP. D2 teachers only design a three-step scientific approach in writing, namely collecting information, associating and communicating. The two steps are not designed in a pure way but only designed implicitly, namely observing and questioning. D2 teachers said they were not used to applying scientific approaches in learning. For this reason, it is necessary to have a deeper understanding of these two steps, what things must be designed, how to plan it still have to learn more.

SMP E, the results showed that E1 teachers have not applied a scientific approach and E2 teachers have applied a scientific approach in learning. E1 teachers still use the conventional approach. The steps of observing and questioning are not designed, while the steps of collecting, associating and communicating are only mentioned without being designed in the LP. The steps of the scientific approach are familiar to E1 teachers, because they have already been learned at the time of training. It's just that it hasn't been applied in learning. E2 teachers only design a three-step scientific approach, namely collecting information, associating and communicating. The two steps of observing and questioning failed to be designed, because understanding was still lacking in both steps, so that at the time of designing felt still confused.

SMP F, F1 teachers and F2 teachers have applied a scientific approach. F1 teachers design in writing the five scientific approaches in LP. While F2 teachers only design in writing three steps, two more steps are designed implicitly, namely observing and questioning. In the observing step, F2 teachers lack understanding about the problems that must be observed by students, still confusing. Likewise with the step of asking, not knowing what to design in the LP. Both steps, according to F2, need more in-depth understanding and explanation.

SMP G, only one teacher has implemented an independent curriculum with a scientific approach, namely G2 teachers while G1 teachers have not applied a scientific approach. But there are three steps designed in the LP that are similar to the scientific approach: gathering information, associating and communicating. The step of observing and questioning is not designed. G2 teachers only two steps are designed in writing, namely the step of associating and communicating. Three steps are only implied design: observing, questioning and gathering information. The G2 teacher said the three steps need to be studied in more detail, because they are still hesitant to design them in the LP.

SMP H, H1 and H2 teachers have applied a scientific approach to the independent curriculum. H1 teachers only designed three scientific approaches, namely collecting information, associating and communicating. Observing is only designed implicitly without explanation. Because the problem designed is in the package book, so it is not designed in writing. While the step of questioning is only

mentioned without being designed. Because according to the H1 teacher, this step is not used to being designed, and it still feels new. H2 teachers design a three-step scientific approach, namely collecting information, associating and communicating. Asking is only implied, because according to the H2 teacher what kind of questions are designed. To observe, it failed to be designed, because H2 teachers felt confused about what kind of problems were designed to arouse student motivation.

SMP I, Teacher I is the only math teacher in SMP I, because SMP I does not have many classrooms. Teachers have not applied learning with a scientific approach, but still conventional teaching. Designing LP there are several steps that are designed the same as the scientific approach, namely collecting information, associating and communicating. Two steps are only mentioned without design, namely observing and questioning. An understanding of the scientific approach is well known when attending K13 training, but has not been applied in learning.

The tenth school is school J which consists of J1 teachers and J2 teachers. Both teachers have applied a scientific approach to learning. J1 teachers can design the five steps of scientific approach in LP. While J2 teachers only design a three-step scientific approach, namely collecting information, associating and communicating. One step is not designed to be observe, because J2 teachers only four steps of scientific approach are known. One more step is to ask questions only designed in a simple manner without writing an explanation. Because the steps of questioning have not been fully understood by the J2 teacher.

Overall, out of ten junior high schools in Aceh Besar with two teachers in each school, only five teachers from SMP A, SMP C, SMP D, SMP F and SMP J designed the LP in writing with a five-step scientific approach. Four junior high schools namely SMP B, SMP E, SMP G and SMP I with teachers namely teachers B1, E1, G1 and teacher I are still conventional learning. While other teachers cannot design the five steps of the scientific approach in writing in the LP. The step of observing and questioning many did not design it, because they still do not understand the steps of the scientific approach. It is hoped that after this research, these teachers will be equipped with an understanding of scientific approaches, so that in the future they can design the five steps of scientific approaches in writing in the LP.

3.2 How Do Junior High School Teachers in Aceh Besar Apply the Scientific Approach?

Overall, all ten schools have implemented scientific approach learning shown in Table 3. Learning through a scientific approach is intended to provide understanding to students in knowing, understanding various materials using a scientific approach, that information usually comes from anywhere, anytime, does not depend on one-way information from the teacher. Therefore, the expected learning conditions created are directed to encourage students to find out from various sources through observation, and not just being told.

Table 3
Teaching with a scientific approach to the Junior High Schools in Aceh Besar

School	Teacher's name	Material	Learning in accordance with LP Teaching					Explained
			M1	M2	M3	M4	M5	
SMP A	Teacher A1	Cube surface area	Lrr	Lrr	Lrr	Lrr	Lrr	Appropriate
	Teacher A2	Area of a circle	Lr	Lrr	Lr	Lrr	Lrr	Appropriate
SMP B	Teacher B1	Rows and rows	TSP	Lr	Lrr	Lr	Lrr	Appropriate
	Teacher B2	Theorem pytagoras	Lrr	TSP	Lrr	Lrr	TSP	Appropriate
SMP C	Teacher C1	Social arithmetic	Lrr	Lrr	Lrr	Lr	Lrr	Appropriate
	Teacher C2	Stastistik	Lr	Lrr	Lr	Lrr	Lrr	Appropriate
	Teacher D1	Surface area of cubes and blocks	Lr	Lrr	Lrr	Lrr	Lrr	Appropriate

	Teacher D2	Angle recognition	Lr	Lr	Lr	Lrr	Lrr	Appropriate
SMP E	Teacher E1	Circle	TSP	Ltd	Ltd	TSP	TSP	Appropriate
	Teacher E2	Profit percentage and loss percentage	TSP	TSP	Lrr	Lrr	Lrr	Appropriate
SMP F	Teacher F1	Social arithmetic	Lrr	Lr	Lrr	Lrr	Lrr	Appropriate
	Teacher F2	Chance	TSP	TSP	Lrr	Lrr	Lrr	Appropriate
SMP G	Teacher G1	Root form and rank	Lr	Lr	Lrr	Lrr	Lrr	Appropriate
	Teacher G2	Social arithmetic	Lrr	TSP	Lrr	Lrr	TSP	Appropriate
SMP H	Teacher H1	Social arithmetic	Lrr	TSP	Lrr	Lrr	Lrr	Appropriate
	Teacher H2	comparison	Lr	TSP	Lrr	Lrr	Lrr	Appropriate
SMP I	Teacher I	Social arithmetic	Lr	TSP	Lrr	Lrr	Lrr	Appropriate
SMP J	Teacher J1	central angle of circumference angle	Lrr	Lrr	Lrr	Lrr	Lrr	Appropriate
	Teacher J2	Profit percentage and loss percentage	TSP	TSP	Lrr	Lrr	Lrr	Appropriate

Table 4
Code used

Code used	**Means**
M1	Observe
M2	Inquired
M3	Collecting information
M4	Reasoning/associating
M5	Communicate
Lr	Implemented, but less sure
Lrr	Implemented, but less sure
Ltd.	Implemented, but do not know the name of the scientific approach
TL	Not implemented

The results showed that A1 teachers and A2 teachers carried out teaching with a scientific approach. Master A1 implements the five steps of the scientific approach confidently in accordance with the planned LP. While A2 teachers can carry out the three-step scientific approach confidently, the other two steps are carried out less confidently, namely observing and collecting information. Because these two steps are still difficult to implement, whether the problems given are in accordance with the material, whether the groups formed by discussion groups are heterogeneous and so on.

SMP B, namely B1 teachers, carry out conventional teaching, but there are steps similar to the scientific approach implemented, namely collecting information and communicating. Two more steps are less sure to be carried out, namely the question step and the association step. One more step is not carried out, namely the observation step. Because according to teacher B1 this step is still new and understanding is also lacking, so it is not carried out in teaching. B2 teachers carry out confidently the three steps of teaching with a scientific approach, namely observing, blunting information and associating. Two more steps, questioning and communicating, are not carried out in teaching. Because in the questioning step there is no reciprocal relationship between teachers and students, while the communication step is not carried out because the time for changing class hours has arrived, so teaching must end.

In SMP C, both teachers have carried out teaching with a scientific approach. C1 teachers confidently implement the four-step scientific approach. One step was carried out unconfidently, namely the association step, because the teacher was late in copying the Student Worksheet (LKP) questions, so while waiting for the questions to arrive, there was a small commotion in the classroom, but after the LKP was distributed, students again seriously completed the LKP. C2 teachers can confidently implement the three-step scientific approach, namely questioning, associating and communicating. Two steps are not implemented with confidence: observing and gathering

information. At the step of observing the teacher seemed hesitant to write down the problem, whether the problem given could be understood by students or not, at the step of collecting information, some students made noise, so in the group discussion I was busy quieting them.

SMP D, namely D1 teachers and D2 teachers, have carried out teaching with a scientific approach. D1 teachers carry out with confidence the four steps of the scientific approach, namely questioning, collecting information, associating and communicating. One step is carried out with less certainty, namely the observing step, because at that step, there are not many props demonstrated, so in carrying out it hesitates, whether it can be observed clearly and can draw conclusions or not by students. D2 teachers can carry out a scientific approach with confidence, namely two steps, associating and communicating. Three steps are carried out less confidently or hesitantly, namely observing, questioning and gathering information. This happens because for D2 teachers the scientific approach is still new and not used to implementing in teaching. It still requires a deeper understanding.

SMP E, namely teacher E1, has not applied a scientific approach in teaching. But there are some steps that are carried out similarly to the scientific approach of questioning and gathering information, although the name of the step is unknown. Three more steps, namely observing and associating, are not carried out, because they do not know the step. Meanwhile, the communication step was not carried out because the class change hour had ended. E2 teachers have applied a scientific approach in teaching, namely the three steps of the scientific approach can be implemented with confidence, namely collecting information, associating and communicating. Two more steps, namely observing and questioning, were not implemented, because the scientific approach for him was still new, so there was still a lack of understanding of the two steps.

SMP F, F1 teachers have confidently implemented these four steps in teaching. One step is carried out with less confidence is the step of questioning, because at this step the F1 teacher does not ask questions and vice versa. The absence of reciprocal relations between teachers and students. F2 teachers carry out the three-step scientific approach with confidence: gathering information, associating and communicating. Two steps were not carried out, namely the observation and questioning steps. According to F2 teachers, the scientific approach is difficult to apply in regular classes. Understanding of these two steps is still lacking, it must be studied more deeply.

SMP G, G1 teachers have not applied a scientific approach in teaching, but there are some similar steps implemented by G1 teachers, namely: gathering information, associating and communicating confidently. While the other two steps, namely observing and questioning, are carried out with less confidence. Although not yet implementing teaching with an independent curriculum, G1 teachers often attend scientific approach training, understanding already exists. G2 teachers confidently implement the three steps of the scientific approach, namely observing, collecting information and associating. Two more steps were not implemented: questioning and communicating. Because the questioning step is not designed in the LP, so it is not implemented in teaching. At the step of communicating there is not enough time to be carried out, because when you want to present the results of the discussion in front of the class, the bell rings to signal the change of lesson.

SMP H, H1 teachers carry out the four steps of scientific approach with confidence, namely observing, collecting information, associating and communicating. One step not implemented is the question step. Because according to the H1 teacher, the understanding of the questioning step is still lacking, so it is not implemented in teaching. H2 teachers carry out the three-step scientific approach with confidence, namely collecting information, associating and communicating. One step is carried out with less certainty, namely observing, because the observing step is still not used to being carried out in teaching, while the questioning step is not carried out, because the understanding is still lacking.

SMP I with teacher I has not carried out teaching with a scientific approach in accordance with the independent curriculum. There are some of the same steps implemented in teaching with a scientific approach, namely three steps. Gathering information, associating and collecting information is carried out with confidence. One step done unsure is the observation step and one step not implemented is the question step. Although it has not applied a scientific approach, the science of this approach already exists, because it has attended scientific approach training several times.

The tenth school is SMP J, J1 teachers can confidently implement the five steps of the scientific approach in teaching, the five steps are implemented in accordance with the LP that has been designed. J2 teachers only carry out three scientific approaches with confidence, namely summing up information, associating and communicating. Two more steps not to be implemented are the steps of observing and questioning. These two steps have not been thoroughly understood by J2 teachers. According to the J2 teacher, these two steps are still unfamiliar and not used to being implemented in teaching.

Thus, it can be concluded that only two teachers can carry out the teaching of the scientific approach confidently namely teachers A1 and J1 and three teachers namely C1, D1 and F1 can carry out the five steps of the scientific approach, but there is one step that is implemented less confidently. Other teachers, on average, can only implement three of the five steps of the scientific approach. To overcome this, the right solution is needed, so that these teachers can impose the five steps of scientific approach in accordance with the independent curriculum in the next mathematics teaching.

3.3 Are Teachers Able to Overcome the Obstacles Faced in Learning Mathematics with a Scientific Approach in Smpaceh Besar?

Overall, all teachers have obstacles in designing and implementing scientific approach teaching in accordance with the independent curriculum. Some can handle it and some have not been able to overcome it. One of them is time management, so there are steps that want to be implemented but are not carried out because the class time ends, this happens to teachers B2, E1 and G2. The procurement of teaching aids is one of the obstacles faced by teachers in teaching mathematics as happened to D1 teachers in the observing step.

Then classroom management is also an obstacle in applying a scientific approach, according to the teacher, the scientific approach is more suitable to be applied in elective classes, such as superior classes or core classes, because in these class's students have a high interest in learning compared to regular classes. This was expressed by F2 teachers and C2 teachers. The main obstacle in addition to the ability to use IT in learning mathematics with a scientific approach is that there are teachers in the ten schools who do not understand the scientific approach, especially the steps of observing and questioning. Because according to them, the scientific approach is still newly applied and not used to learning. It is hoped that in the future these obstacles can be overcome, so that mathematics learning with a scientific approach runs as it should.

Junior high school teachers in Aceh Besar Regency are able to teach well but fail to use a scientific approach to the steps contained in the LP in accordance with the implementation of the Merdeka Belajar curriculum. To examine this, researchers observe and channel performance to achieve research goals. As the next step, researchers held a workshop for junior high school teachers in Aceh Besar Regency on on Improving the Scientific Approach Capability of Junior High School Teachers in Aceh Besar Regency in Table 5. In the workshop, individual and detailed instructions will be given on the nature, how to structure junior high school mathematics learning with a Scientific approach and

apply it. Experts guide Mathematics learning, peer teaching, and then actual teaching with the help of a research team.

Table 5
Overview of the understanding of Aceh Besar Junior High School teachers about scientific learning as an independent curriculum

No.	Observed aspects	Value				
		1	**2**	**3**	**4**	**5**
I	*Ability to observe*					
1	The teacher asks several things related to the student environment that are in accordance with the material	2	2	11	6	4
2	The teacher associates' objects around the student to help the student relate them to the material	3	1	9	7	5
3	The teacher displays objects that students can observe to relate them to the concept of the lesson	3	8	6	4	4
4	The teacher invites students to pay attention to objects around that can be used to understand the subject matter	1	4	12	5	3
	Sum	9	15	38	22	16
	Percentage (%)	9	15	38	22	16
II	*Questioning ability*					
1	Teachers provide many opportunities to students to ask questions, practice and interact with other students,	2	4	12	4	3
2	The teacher communicates information about the material to be studied according to the age and level of learning ability of students,	3	7	6	4	5
3	The teacher gives examples that do not match the students' understanding so that it makes them ask questions	3	4	5	8	4
4	Teachers deliver material in various ways to arouse students' interest in asking questions	6	6	8	4	7
5	Teachers ask various questions to awaken students' thinking power to be able to provide similar questions for other problems in learning	3	6	7	5	4
	Sum	11	27	38	25	23
	Percentage (%)	8,8	21,6	30,4	20	18,4
III	*Ability to collect information*					
1	Teachers present learning activities that require students to get information	3	4	7	6	5
2	The teacher pays attention and listens to all questions and responses of learners, without interrupting, unless necessary to help or clarify the question/response.	2	3	8	7	5
3	The teacher instructs students to give an opinion on an object	1	7	10	3	4
4	Teachers provide opportunities for students to express opinions, provide responses, and answer other students' questions	3	5	6	6	5
5	Teachers teach students to think critically about the information provided	3	4	8	7	3
6	Teachers foster confidence for students to express opinions and / or questions	4	6	5	5	5
	Sum	16	29	44	34	27

	Percentage (%)	11	19	29	23	18
IV	*Reasoning ability*					
1	The teacher gives questions related to previous competencies	2	5	5	7	6
2	Teachers use media that invites students' attention to ask questions	3	4	5	8	5
3	The teacher invites students to analyze a problem together	4	8	7	3	3
4	The teacher invites students to relate the problem to several concepts	4	6	4	7	4
5	Teachers systematically present problems from easy to difficult to train students' reasoning	1	5	9	5	5
6	The teacher provides questions that require solving *high thinking*	2	6	8	6	3
	Sum	16	34	38	36	26
	Percentage (%)	16	34	38	36	26
V	*Mathematical communication skills*					
1	The teacher displays some objects and asks students to give some arguments regarding the picture	4	6	6	5	4
2	Invite students to come together seeks to provide a narrative on a mathematical model presented	5	6	7	5	2
3	Requires students to describe things that can be related from the material being studied	5	6	5	6	3
	Sum	14	18	18	16	9
	Percentage (%)	19	24	24	21	12
VI	*Troubleshooting*					
1	Ask students to gather important information in a problem	3	7	7	5	3
2	Provide opportunities for students to provide a problem related to everyday life	4	6	9	4	2
3	Ask students to think of a problem related to the material	4	6	7	5	3
4	Invite students to provide solutions to the problems presented	5	5	6	5	4
	Sum	16	24	29	19	12
	Percentage (%)	16	24	29	19	12
	Total Amount	105	152	206	155	126
	Average	18	25	34	26	21
	*Category	D	C	B	C	C

**Description A=Very good, B=Good, C= Sufficient, D= less*

The description of the results based on Table 5 obtained is as follows:

i. Ability to observe

The competence of the teacher's scientific understanding in the aspect of observing consists of 4 aspects observed. Of the four aspects, the teacher aspect invites students to pay attention to objects around that can be used to understand the subject matter received the highest rating, which is 38 with a good category.

ii. Questioning Ability

For the aspect of questioning ability consists of 5 aspects observed. Of the five aspects, the Teacher aspect provides many opportunities for students to ask questions, practice and interact with other students obtaining a score of 38 with a category of 30.4%

iii. Ability to Collect Information

The aspect of collecting information consists of 6 aspects. Aspect The teacher instructs students to give an opinion on an object obtaining a total of 44 (29%).

iv. Reasoning Ability

The aspect of reasoning ability has 6 aspects and among these 6 aspects, the teacher aspect provides problems systematically from easy to difficult to train the reasoning of students obtaining the highest number of 38 (38%).

v. Mathematical Communication Skills

The communication aspect scored the highest in the aspect of Inviting students to jointly seek to provide a narrative on a mathematical model presented, which is 18 (24%)

vi. Troubleshooting

The aspect of providing opportunities for students to provide a problem related to daily life obtained the highest number of 29 (29%) from other aspects. Overall, the scientific understanding of junior high school teachers in Aceh Besar Regency has not been maximized. Only the ability to collect information is categorized very well. While the ability to ask questions and solve problems gets a good category. This condition can be seen from the following Figure 1.

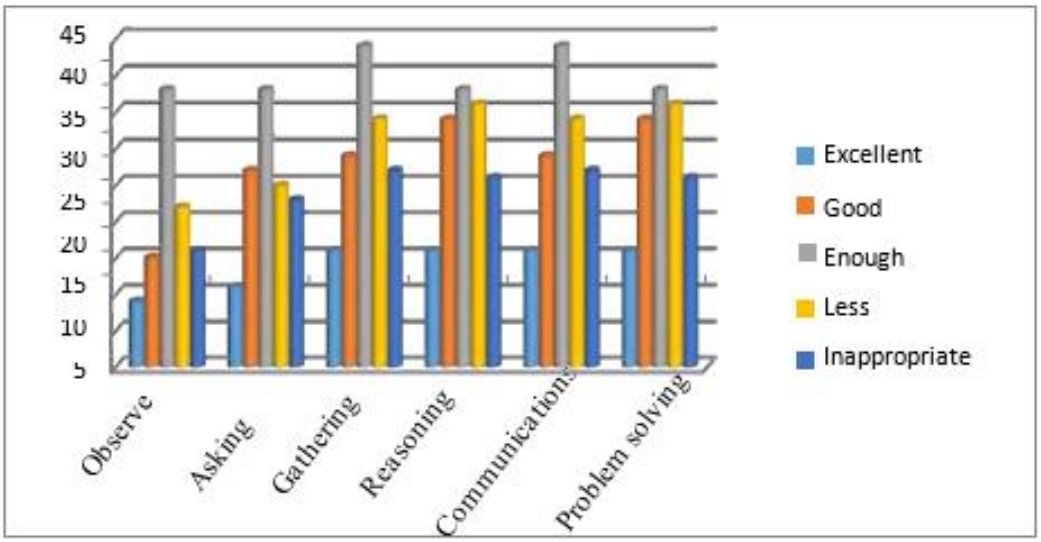

Fig. 1. Graph of scientific comprehension ability of junior high school teachers in Aceh Besar Regency

4. Conclusion

This study explored the implementation of the Scientific Approach in mathematics learning at the junior high school (SMP) level in Aceh Besar Regency. Based on the findings, several key conclusions can be drawn:

i. Teachers' Ability to Design Learning Using a Scientific Approach

Mathematics teachers in Aceh Besar Regency have demonstrated the ability to develop lesson plans using a Scientific Approach. However, this ability is primarily acquired through input from fellow teachers and is often based on imitation rather than a deep understanding of the pedagogical principles behind the approach. Many teachers are not fully aware of the rationale for selecting specific operational verbs, structuring learning activities, and

implementing certain instructional steps. This indicates the need for further training to enhance their conceptual grasp of the methodology.

ii. Implementation of the Scientific Approach in Classroom Teaching
Observations reveal that teachers actively apply the Scientific Approach in their classroom instruction. The lesson plans and teaching strategies they use are generally the result of collaborative discussions among teachers, reflecting a shared effort to implement best practices. However, there is room for improvement in ensuring that the application is not only procedural but also aligned with the intended learning objectives and cognitive development of students.

iii. Teachers' Competency in Applying the Scientific Approach
The overall competency of mathematics teachers in implementing the Scientific Approach is categorized as good. This competency is largely derived from their teaching experience, which enables them to adapt and refine their instructional practices over time. However, continuous professional development and targeted training programs are essential to deepen their understanding and enhance the effectiveness of their teaching strategies.

5. Recommendations

Based on these conclusions, it is recommended that:

i. Teachers receive structured professional development opportunities to strengthen their theoretical understanding of the Scientific Approach.
ii. Training sessions emphasize not only the procedural aspects but also the pedagogical reasoning behind lesson design.
iii. Schools facilitate ongoing teacher collaboration and peer-learning initiatives to improve the quality of mathematics instruction.
iv. Further research be conducted to assess the impact of the Scientific Approach on students' mathematical comprehension and problem-solving skills.
v. By addressing these areas, mathematics education in Aceh Besar Regency can be further improved, ensuring that students receive high-quality learning experiences that foster critical thinking and conceptual understanding.

Acknowledgements

The research is not funded with any grant.

References

[1] Assingkily, Muhammad Shaleh. "Upaya Mewujudkan Program Kampus Merdeka Pada Kurikulum PGMI STIT Al Ittihadiyah Labuhanbatu Utara." *At-Thullab: Jurnal Pendidikan Guru Madrasah Ibtidaiyah* 4, no. 2 (2020): 62-77. https://doi.org/10.30736/atl.v4i2.263

[2] Nurani, D., and L. Anggraini. "Misiyanto, & Mulia, KR (2022)." *Serba-Serbi Kurikulum Merdeka: Kekhasan Sekolah Dasar. Tim Pusat Kurikulum dan Pembelajaran (Puskurjar), BSKAP* (2022).

[3] Maulana, Noveri. "Toward sustainable higher education: Integrating soft skill development into business school curriculum in Indonesia." *Journal of Law and Sustainable Development* 11, no. 4 (2023): e325-e325. https://doi.org/10.55908/sdgs.v11i4.325

[4] Ulia, Nuhyal. "Peningkatan pemahaman konsep matematika materi bangun datar dengan pembelajaran kooperatif tipe group investigation dengan pendekatan saintifik di SD." *Jurnal Tunas Bangsa* 3, no. 2 (2016): 55-68.

[5] Rahmansyah, Muhammad Fahmi. "Merdeka belajar: Upaya peningkatan mutu pembelajaran di sekolah/madrasah." *Ar-Rosikhun: Jurnal Manajemen Pendidikan Islam* 1, no. 1 (2021): 47-53. https://doi.org/10.18860/rosikhun.v1i1.13905

[6] Sufairoh, Sufairoh. "Pendekatan saintifik dan model pembelajaran K-13." *Jurnal Pendidikan Profesional* 5, no. 3 (2017): 116-125.

[7] Alfath, Annisa, Fara Nur Azizah, and Dede Indra Setiabudi. "Pengembangan kompetensi guru dalam menyongsong kurikulum merdeka belajar." *Jurnal Riset Sosial Humaniora Dan Pendidikan* 1, no. 2 (2022): 42-50. https://doi.org/10.56444/soshumdik.v1i2.73

[8] Alirahman, Agus Dian, Mohamad Syarif Sumantri, and Muhammad Japar. "The development of islamic religious education and character materials online based in elementary schools." *Journal of Law and Sustainable Development* 11, no. 6 (2023): e550-e550. https://doi.org/10.55908/sdgs.v11i6.550

[9] Wijayanti, A. "Pengembangan autentic assesment berbasis proyek dengan pendekatan saintifik untuk meningkatkan keterampilan berpikir ilmiah mahasiswa." *Jurnal Pendidikan IPA Indonesia* 3, no. 2 (2014). https://doi.org/10.15294/jpii.v3i2.3107

[10] Ahmad, Edy. "Upaya meningkatkan kompetensi pedagogik guru dalam menerapkan proses pembelajaran berbasis pendekatan saintifik melalui supervisi kunjungan kelas di SMPN 18 Dumai." *Jurnal PAJAR (Pendidikan dan Pengajaran)* 3, no. 4 (2019): 859-869. https://doi.org/10.33578/pjr.v3i4.7519

[11] Sumintono, Bambang. "Pembelajaran sains, pengembangan keterampilan sains dan sikap ilmiah dalam meningkatkan kompetensi guru." *Al-Bidayah: Jurnal Pendidikan Dasar Islam* 2, no. 1 (2010). https://doi.org/10.14421/al-bidayah.v2i1.8988

[12] Wulandari, Dewi. "Kompetensi Profesionalisme Guru." *Aksioma Ad-Diniyah: The Indonesian Journal of Islamic* 9, no. 1 (2021). https://doi.org/10.55171/jad.v9i1.535

[13] Sholihah, M., K. Ratnasari, Y. D. Permatasari, U. Muawanah, and A. N. F. Fajri. "The policy of educators' certification: an effort to improve quality, qualification, and teachers' competence." In *IOP Conference Series: Earth and Environmental Science*, vol. 485, no. 1, p. 012130. IOP Publishing, 2020. https://doi.org/10.1088/1755-1315/485/1/012130

[14] Muthy, Anisa Nurfalah, and Heni Pujiastuti. "Analisis media pembelajaran e-learning melalui pemanfaatan teknologi dalam pembelajaran matematika di rumah sebagai dampak 2019-nCoV." *Jurnal Math Educator Nusantara: Wahana Publikasi Karya Tulis Ilmiah Di Bidang Pendidikan Matematika* 6, no. 1 (2020): 94-103. https://doi.org/10.29407/jmen.v6i1.14356

[15] Hakim, Adnan. "Contribution of competence teacher (pedagogical, personality, professional competence and social) on the performance of learning." *The International Journal of Engineering and Science* 4, no. 2 (2015): 1-12.