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Implementation Of The STEM Approach to Science Learning at MI Nurul Huda Sidokumpul Guntur Demak

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Abstract Study This aim for describe implementation Science Technology Society (STEM) approach to science learning at MI Nurul Huda Sidokumpul, Guntur District, Demak Regency. In study at this time, STEM learning was implemented through activity experiment water hyacinth Hyacinth (*Eichhornia crassipes*) as a simple and easy observation medium understood participant educate Elementary Madrasah level. Participants educate observing two containers water hyacinth goiter for 5 days: Container A contains clean water and Container B contains water mixed with soap. Observation results show that water hyacinth goiter in Container B experienced wilting since day 2 and died completely on day 5, while water hyacinth goiter in Container A remains grow fertile. Research use method qualitative descriptive with technique data collection in the form of observation, interview in-depth, and documentation. Subject study is participant educate Class V. Research results show that implementation STM approach is implemented through five stages: (1) invitation, (2) exploration, (3) explanation and solution, (4) decision making action, and (5) strengthening concept. The implementation of this approach has been shown to increase enthusiasm, active student involvement, and environmental awareness. The main obstacles identified were limited laboratory facilities and a lack of relevant local references. This study concludes that the STM approach is effective in science learning in Islamic elementary schools if supported by careful planning and adequate teacher pedagogical competence.

Keywords: *STEM Approach, Water Hyacinth Goiter, Pollution Detergent, Science Learning*

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Abstrak Penelitian ini bertujuan untuk mendeskripsikan implementasi pendekatan Sains Teknologi Masyarakat (STM) pada pembelajaran IPAS di MI Nurul Huda Sidokumpul, Kecamatan Guntur, Kabupaten Demak. Dalam penelitian ini, pembelajaran STM dilaksanakan melalui kegiatan eksperimen eceng gondok (*Eichhornia crassipes*) sebagai media observasi yang sederhana dan mudah dipahami peserta didik tingkat Madrasah Ibtidaiyah. Peserta didik mengamati dua wadah eceng gondok selama 5 hari: Wadah A berisi air bersih dan Wadah B berisi air yang dicampur sabun. Hasil pengamatan menunjukkan bahwa eceng gondok pada Wadah B mengalami kelayuan sejak hari ke-2 dan mati total pada hari ke-5, sementara eceng gondok pada Wadah A tetap tumbuh subur. Penelitian menggunakan metode kualitatif deskriptif dengan teknik pengumpulan data berupa observasi, wawancara mendalam, dan dokumentasi. Subjek penelitian adalah peserta didik kelas V. Hasil penelitian menunjukkan bahwa implementasi pendekatan STM dilaksanakan melalui lima tahapan: (1) invitasi, (2) eksplorasi, (3) penjelasan dan solusi, (4) pengambilan tindakan, dan (5) pemantapan konsep. Implementasi pendekatan ini terbukti meningkatkan antusiasme, keterlibatan aktif peserta didik, dan kesadaran lingkungan. Hambatan utama yang ditemukan adalah keterbatasan sarana laboratorium dan minimnya referensi lokal yang relevan. Penelitian ini menyimpulkan bahwa pendekatan STM efektif diterapkan dalam pembelajaran IPAS di madrasah ibtidaiyah apabila didukung oleh perencanaan yang matang dan kompetensi pedagogis guru yang memadai.

Kata Kunci: Pendekatan STM, eceng gondok, pencemaran detergen, pembelajaran IPAS.

A. INTRODUCTION

Learning Knowledge Natural and Social Knowledge (IPAS) in The Independent Curriculum is eye integrated lessons dimensions science and social as One a complete unity. Decision of the Minister of Education, Culture, Research and Technology Number 56/M/2022 stipulates guidelines implementation curriculum in frame recovery learning that emphasizes importance learning meaningful, contextual, and based experience real participant educate. (Minister of Education, Culture, Research, and Technology of the Republic of Indonesia, 2022)

In Madrasah Ibtidaiyah (MI), the implementation of IPAS has challenge alone Because must consider values Islam that becomes characteristics institutional. Therefore that, is necessary approach learning that is not only capable convey content science in a way academic, but also can connect it with life social surrounding community participant educate. One of the relevant approach is Science Technology Society (STS). Research conducted by (Abel Tri Fatimah & Syahran Jailani, 2025) prove

that implementation STM approach in elementary madrasas can increase attitude care environment participant educate in a way significant.

STM approach was first introduced by educators science in the beginning 1980s as response on concern that science learning is too abstract and disconnected from reality social. (Poedjiadi, 2019) defines STM as approach learning that relates between draft science, technology used humans, and their impacts to public as well as environment life.

In this study, the STM approach is implemented through activity experiment water hyacinth Hyacinth (Eichhornia crassipes) as a simple, cheap and easy learning medium understood by participants educate MI level. (Yulianto et al., 2021) explain that water hyacinth hyacinth (Eichhornia crassipes) can used as bioindicators at a time agent phytoremediation for show impact pollution detergents in the ecosystem waters, so that relevant used as an experimental medium learning based environment.

The STM approach has proven relevant for developing critical thinking skills and student achievement. (Sri Evariani et al., 2017), in their study, concluded that the STM learning model consistently improved students' critical thinking skills and social studies learning achievement. Similar findings were also presented by (Suwintara et al., 2013), who found that the STM approach positively influenced students' scientific attitudes and science learning outcomes in elementary school.

The development of critical thinking skills in science/science studies at Islamic elementary schools (MI) still faces various obstacles, particularly the lack of media use and learning approaches that actively engage students. Research (Fani et al., 2021) shows that students still experience difficulties in solving Higher Order Thinking Skills (HOTS) questions, particularly in indicators C5 and C6. This situation highlights the importance of implementing learning approaches that can develop students' critical thinking skills, one of which is the Science, Technology, and Society (STM) approach, which emphasizes investigative activities and hands-on learning experiences through simple experiments.

MI Nurul Huda Sidokumpul, located in Guntur District, Demak Regency, is one of the elementary Islamic educational institutions that has implemented the Independent Curriculum since the 2022/2023 academic year. During its implementation, science teacher Mr. Abdul Aziz, M.Pd.,

faced various challenges, ranging from limited learning media, a lack of relevant local references, to the need to adapt learning approaches to the diverse characteristics of students. (Trianto, 2020) emphasized that in the integrated learning paradigm, the STM approach can be used as a bridge between academic content and students' daily life experiences.

The development of STM-based student worksheets (LKPD) has also been shown to improve students' scientific literacy. (Pratama, 2017) succeed prove improvement literacy significant science to participants educate through LKPD with STM approach to material pollution environment. In line with that, (Jayanti et al., 2019) find that the STM learning model has an influence positive to results science learning reviewed from digital literacy of participants educate class V school base. (Rusmiyati & et al., 2024) also shows that device designed learning in accordance STM principles in general effective increase achievements learning and motivation intrinsic participant educate.

Although research the has give a pretty good picture comprehensive, not yet Lots studies that are specific research implementation STM approach to science learning in elementary madrasas in rural areas Demak Regency with using appropriate experimental media ability participant MI education. (Galuh Rahayuni, 2016) confirm that STM approach is more effective in develop skills think critical and literacy science participant educate in a way simultaneously compared to learning models based problem (PBM).

Research purposes This is: (1) describing stages implementation STM approach in Science learning at MI Nurul Huda Sidokumpul through experiment water hyacinth goiter, (2) identify factors supporters and inhibitors implementation, and (3) formulating solutions that can implemented for optimize STM approach in elementary madrasah. With Thus, research This expected can give contribution theoretical and practical for development more science learning meaningful and contextual.

B. METHOD

Study This use approach qualitative with type study descriptive approach qualitative descriptive chosen Because objective study is for describe and understand in a way deep phenomenon implementation STM approach in context Science learning at MI Nurul Huda Sidokumpul as being in the field, without do manipulation variables or testing hypothesis. Approach This allows

researchers for obtain rich, holistic and contextual data regarding the process, obstacles, and factors that influence implementation STM approach.

Study held at MI Nurul Huda Sidokumpul, Guntur District, Demak Regency, Central Java, during the even semester year 2024/2025 academic year. Activities observation implemented on May 2, 2025.

Subject study consists of from: (1) class V science and science teacher Mr. Abdul Aziz, M.Pd., as source person main, (2) head of madrasah as informant key, and (3) 30 participants educate class V is divided into 6 groups experiment (5 people per group), selected in a way purposive based on criteria involvement direct in activity experiment water hyacinth goiter.

The data collection techniques used included three main methods. First, participatory observation was conducted during the learning process and the water hyacinth experiment to directly observe the implementation of the five stages of STM. Second, in-depth interviews were conducted with science teachers and the madrasah principal using a semi-structured interview guide. Third, documentation was conducted using experimental worksheets, group observation reports, teaching modules, and photo documentation of the activities.

Data analysis was conducted using the Miles and Huberman interactive analysis model, which consists of three stages: (1) data reduction, (2) data presentation, and (3) drawing conclusions and verification. Data validity was guaranteed through source triangulation, method triangulation, and member checking with research participants (Suharsimi Arikunto & Supardi, 2021) .

Experimental design water hyacinth goiter using two containers plastic transparent. Container A is filled with clean water (control) and Container B is filled with water mixed with soap wash (treatment). Each is planted One clump water hyacinth fresh goiter. Observation done every day for 5 days by 6 groups participant educate use sheet Work simple, with task observation different as listed in Table 1.

Table 1. Distribution Groups and Assignments Observation Experiment Water hyacinth Goiter

Kel.	Member	Task Observation
1	5 participants educate	Observing color and shape leaf water hyacinth goiter in both receptacle every day
2	5 participants educate	Observing condition stem: what upright, limp, or broken
3	5 participants educate	Observe the condition of the roots: color and length every day.
4	5 participants educate	Observing water color on both container and record the changes
5	5 participants educate	Document changes by drawing the condition of the plants every day.
6	5 participants educate	Compile a summary report and present the results of group observations

C. RESULTS AND DISCUSSION

1. Overview of the Implementation of the STM Approach at MI Nurul Huda Sidokumpul

MI Nurul Huda Sidokumpul has systematically implemented the STM approach in science learning since the beginning of the Merdeka Curriculum in the 2022/2023 academic year. In the even semester of 2024/2025, a fifth-grade teacher designed a five-day water hyacinth experiment as a concrete implementation of the exploration stage in the STM cycle. This involving 30 participants educate in 6 groups, each consisting of 5 people, with instrument sheet Work experiment structured.

Figure 1. Infographic Practice STM Learning: Experiments Water hyacinth Goiter in Class V of MI Nurul Huda Sidokumpul — 30 Students in 6 Groups

Figure 1 shows infographics activity STM experiment in class. All 6 groups looks active observing two containers labeled ' Clean Water ' and 'Water + Soap ', note results on the sheet work, and discuss in group. Context activities that are of a nature direct and concrete This in accordance with principle STM learning that emphasizes involvement active participant educate in investigation scientific based issue real.

2. Stages Implementation STM approach

1. Invitation Stage

Stage invitation is phase an opening where the teacher presents issue or problem real from environment public around for arouse curiosity knowledge and motivation Study participant educate. Based on observations conducted in class V MI Nurul Huda Sidokumpul, Mr. Abdul Aziz, M.Pd., opened learning with display picture condition rivers and canals irrigation in Guntur District which is visible cloudy and foamy consequence soapy water disposal from activity House stairs. The teacher then displays two containers containing water hyacinth goiter in front class and apply question igniter: "What do you think will happen? occurs in plants water hyacinth goiter This if We soak in soapy water during a number of day?"

Interview results with Mr. Abdul Aziz revealing that election water hyacinth goiter as an experimental medium based on several considerations: (1) plants This easy found in the channel irrigation around the madrasah without costs, (2) changes can observed visually by participants educate MI without tool specifically, and (3) its relevance with issue environment real close with life participant educate. The teacher stated that stage effective and contextual invitations is key for maintain involvement participant educate throughout cycle STM learning.

2. **Stage Exploration**

At the stage exploration, 30 participants divided education in 6 groups (5 people per group) do activity investigation in a way active and structured for 5 days. Every group observe condition water hyacinth goiter in both receptacle in accordance each task and record it on the sheet Work simple designed in accordance ability participant MI education. Activities exploration covers visual observation of: (a) color and shape leaves, (b) condition stem (upright, limp, or wilted), (c) condition root, and (d) the color of the water in the second receptacle. Findings This in line with results study (Sri Evariani et al., 2017) which concludes that exploration direct is component most important in increase performance Study through the STM model.

Table 2. Results of Daily Observations of Water Hyacinth for 5 Days

Aspect Observation	Day 1	Day 2	Day 3	Day 4	Day 5
Leaf Color (A / B)	Fresh green / Normal green	Fresh green / A little pale	Fresh green Yellowing tips	Fresh green / Yellow & wilted	Fresh green / Yellow & dry
Condition Stem (A / B)	Upright and sturdy / Normal	Upright / Slightly weak	Upright and sturdy Weak	Firmly upright / Very weak	Upright and firm / Lying and withered
Root Condition (A / B)	Pure white / Normal	Pure white / Pale	Pure white Pale fragile	Pure white / Starting to rot	Pure white / Rotten black
Water Color (A / B)	Clear / A little foamy	Clear / Foamy	Clear Foaming cloudy	Clear / Cloudy & smelly	Clear / Very cloudy

Condition Conclusion (A / B)	Healthy / Almost Healthy	Healthy / Starting to be disturbed	Healthy Disturbed	Healthy / Seriously ill	Healthy / Dead

Description: A = Clean Water Container (Control), B = Mixed Water Container Soap (Treatment)

The data in Table 2 shows very clear and easy pattern understood participant MI education: conditions water hyacinth goiter in Container B (mixed water) soap) decreases in a way gradually from day to day. Change First seen on the 2nd day with leaves that are starting to pale, then increase become leaf yellowing on the 3rd day, wilting severe on the 4th day, and completely dead on the 5th day. In contrast, water hyacinth goiter in Container A (clean water) maintains condition healthy and fresh all 5 days observation. Simple data This easy read and analyzed by participants educate class V MI without need tool measuring complex laboratory. (Yulianto et al., 2021) explain that exposure surfactant detergent (LAS) can influence morphology and growth aquatic plants so that cause visual changes such as wilting and decline biomass plant.

Table 3. Summary Change Water Hyacinth Condition per Day

Day	Container A – Clean Water	Container B – Mixed Water Soap
Day 1	green leaves, stems upright, roots white clean, clear water	The leaves are still green but start A little pale, condition almost the same with Container A
Day 2	All conditions remain good, no negative changes	Leaf tip start seen more pale, stem start A little weak
Day 3	Growing normally, very good condition	The leaves are starting to yellowing in parts edge, stem weak, roots pale
Day 4	condition, roots white thick and long	Yellow and wilted leaves, stems fall down, root start rotting, the water is cloudy and smelly
Day 5	Very fresh and healthy, best condition	Plant total wilting of roots black rotting, very cloudy water

3. Stage Explanation and Solution

After 5 days observation, every group presenting results his findings and discuss for formulate explanation as well as solution on observed problems. In the phase In this case, Mr. Abdul Aziz plays

a role as facilitator who helps participant educate connect findings empirical with simple explanations and appropriate to MI level, for example: soap and detergent make water ' poison ' for plant, dead water plants will making fish and other aquatic animals no place shelter, and habits throw away the soapy water to river impact directly to the damage surrounding aquatic ecosystems We (Abel Tri Fatimah & Syahran Jailani, 2025)

Based on observation, participants educate capable formulate solutions appropriate innovative with capabilities and context life they as MI children, including: (1) reducing use soap and detergent at home, (2) no throw away used water laundry direct to river or channel irrigation, (3) using more soap friendly environment, and (4) utilizing used water laundry For water plant land after diluted. (Rusmiyati & et al., 2024) confirm that in learning STM- based, structured LKPD with good in phase explanation and solution capable increase ability participant educate in analyze problem in a way systematic and formulate alternative solution data- based.

4. **Stage Taking Action**

In phase taking action, participant educate pushed For implement solutions that have been they formulate in form action real. Based on observations, fifth grade students of MI Nurul Huda Sidokumpul carried out the following activities: (1) making a simple educational poster with the theme "Protect Our River! Don't Throw Soapy Water into the River" which was attached to the madrasah information board and taken home to be displayed in their respective homes, (2) demonstrating a water hyacinth experiment to fourth and sixth grade students as a form of dissemination of learning outcomes, and (3) making a written commitment in groups about environmentally friendly habits that they will apply daily.

(Makhvudah et al., 2020) in their research concluded that the real action phase in the STM cycle is the most influential component in shaping students' social awareness and responsibility, and is the main difference between the STM approach and the conventional science learning approach.

5. **Stage Consolidation Draft**

In phase Finally, Mr. Abdul Aziz did consolidation draft through discussion class reflective, evaluation structured, and strengthening conceptual. Based on results interview phase This integrated with activity literacy science appropriate MI level, where participants educate requested For write report experiment simple in an easy format understood: what is observed, what happens, and what

lessons that can be learned taken. Teachers also use exit ticket technique in the form of three question brief and assessment self -assessment as instrument assessment formative phase this. (Trianto, 2020) confirm that consolidation effective concept in framework learning integrated requires assessment strategies authentic capable measure understanding conceptual at a time science process skills participant educate.

3. Influence STM approach to Scientific Literacy and Critical Thinking Skills

One of most significant impact from implementation STM approach through experiment water hyacinth goiter at MI Nurul Huda Sidokumpul is improvement literacy science and ability think critical participant educate at the appropriate level with MI level. Based on the results data interview with Mr. Abdul Aziz, participant students involved in experiment This show more capabilities Good in: (a) observing changes and record them in a way systematic, (b) submit suspicion simple (hypothesis) before observation, (c) reading and interpreting table as well as chart results observation, and (d) interesting conclusion based on proof real that they observe Alone.

This finding is in line with a study conducted by (Mirna et al., 2022) which proved that the use of concrete and visual sensing-based learning media significantly improves students' critical thinking skills in science learning at the MIN/MI level. The study showed that the calculated t value (4.661) was greater than the t table (2.011) at a significance level of 0.05, thus indicating a positive influence of the use of learning media on students' critical thinking skills. The use of water hyacinth experiment media in this study is in line with these findings, because direct student involvement in concrete and meaningful science activities has been shown to be more effective in developing critical thinking skills than abstract and passive learning.

Rahayuni (2016) specifically compared the effectiveness of the STM approach and the problem-based learning (PBL) model in developing students' critical thinking skills and scientific literacy. The results of her study showed that the STM approach was superior in developing scientific literacy, while both approaches demonstrated equal effectiveness in developing critical thinking skills.

4. Supporting Factors Implementation STM approach

Based on results research, there are a number of supporting factors success implementation STM approach at MI Nurul Huda Sidokumpul. First, the competence and dedication of the science

teachers. Mr. Abdul Aziz, M.Pd., has follow training Independent Curriculum organized by the Ministry of Religion Demak Regency and in general independent develop design experiment water hyacinth affordable and suitable goiter ability participant MI education. (Abel Tri Fatimah & Syahran Jailani, 2025) mention that competence teacher pedagogical is the most determining factor in success implementation STM approach in elementary madrasah.

Second, the availability of local experimental materials. Water hyacinth is easily found in irrigation channels around Guntur District, so it requires no procurement costs. Soap, as the treatment material, is also very familiar to students, making this experiment relevant, easy to understand, and replicable at home. Third, the support of madrasah leadership. The principal of MI Nurul Huda Sidokumpul consistently provides support in the form of freedom for teachers to innovate and provides a budget for the procurement of science learning tools and materials. Fourth, a culture of teacher collaboration. The Guntur District-level KKG forum serves as a forum for sharing teaching modules and simple science experiment designs among science teachers.

5. Inhibiting Factors and Strategic Solutions

Obstacle first and most significant is limitations means laboratory. This madrasah Not yet own adequate science laboratory, so that activity experiment must done in the room class with tools and materials simple. Although thus, precisely limitations This push teacher creativity in designing simple experiment However meaningful, such as experiment water hyacinth goiter only need receptacle plastic, water, and soap.

Obstacle second is lack of relevant local references and teaching materials with experiment water hyacinth goiter in MI context. Teachers must in a way independent develop experimental LKPD, which requires time and energy extra outside teaching hours. (Sri Evariani et al., 2017) take notes that development quality contextual teaching materials is prerequisite essential for effective implementation of STM.

The third obstacle is the high heterogeneity of student abilities. To overcome these obstacles, Mr. Abdul Aziz and the principal of the madrasah have taken several strategic steps: (1) utilizing classrooms as mini laboratories that are rearranged with group tables, (2) selecting experimental materials that are easily obtained for free from the environment around the madrasah, (3) developing LKPD with simple language and accompanied by guide pictures that are easy for MI students to

understand, and (4) implementing differentiated learning strategies through heterogeneous student grouping with a peer mentoring system (Sudjana & Rivai, 2019) .

6. Impact of Implementation on Students' Scientific Attitudes and Character

In addition to the cognitive impact of increasing scientific literacy and critical thinking skills, the implementation of the STM approach through the water hyacinth experiment at MI Nurul Huda Sidokumpul also has a positive affective impact, especially in the formation of scientific attitudes and student character. Based on the results of observations and interviews with Mr. Abdul Aziz, students involved in this experiment showed the development of scientific attitudes which include: high curiosity, objectivity in recording and reporting changes in plant conditions, honesty in reporting observation results even if they do not match initial expectations, and openness to new scientific explanations.

This finding is consistent with research (Suwintara et al., 2013) which demonstrated that the STM approach significantly improved elementary school students' scientific attitudes compared to conventional learning. The identified impacts on character development include increased environmental awareness and responsibility, demonstrated by students' initiatives to reduce excessive detergent use at home and reminding parents not to dispose of soapy water into rivers.

(Jayanti et al., 2019) confirm that integration digital literacy in the STM learning model is increasingly strengthen impact positive approach This to results learning and attitude participant education in the digital era. In overall, implementation STM approach through experiment water hyacinth goiter at MI Nurul Huda Sidokumpul has show positive and promising results. Fatimah and Jailani (2025) emphasized that STM approach in elementary madrasas No only succeed increase attitude care environment, but also capable of form participant more education active, critical, and responsive to problem social around they.

CONCLUSION

Based on results research and discussion that has been described, can withdrawn a number of conclusion as following. First, implementation STM approach in Science learning at MI Nurul Huda Sidokumpul, Guntur District, Demak Regency was carried out through five systematic and interconnected stages related, namely invitation, exploration, explanation and solution, decision making action and strengthening concept. Experiment water hyacinth goiter (Container A: clean

water, Container B: mixed water soap) observed for 5 days succeed show visually and easily understood that detergent impact negative to growth aquatic plants: water hyacinth goiter in Container B begins withered since day 2 and completely died on day 5, while Container A remained fresh and healthy.

Second, the factors support main implementation The STM approach includes: the competence and dedication of the science teacher Mr. Abdul Aziz, M.Pd., in develop experiments that are appropriate to MI level, availability water hyacinth goiter as material experiment free and easy local obtained, support madrasa leadership, as well as culture teacher collaboration through the KKG forum. Obstacles main issues faced is limitations means laboratory, lack of ready LKPD use for experiment water hyacinth goiter at MI level, and heterogeneity ability participant educate.

Third, implementation STM approach through experiment water hyacinth goiter proven give impact significant positive: increase enthusiasm and involvement 30 active participants educate in 6 groups experiments, development ability think critical and literacy appropriate science MI level, formation attitude scientific positive, and growth awareness and responsibility answer environment related impact detergents in the ecosystem waters local.

Based on conclusion said, researchers recommends that: (1) the Ministry of Religion Demak Regency held training development contextual teaching materials STM -based with experimental media simple and appropriate ability participant educate MI in a sustainable, (2) each MI allocates budget special For procurement tools and materials learning science simple that can found in the environment around, (3) science teachers are encouraged For develop and document design STM-based experiments material local that has field tested, and (4) research advanced need done For measure impact term long implementation STM approach through experiment simple based natural to literacy science and character participant MI education.

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