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The Implementation of the Integrated STEAM Approach to Improve Students' Interest in Science

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Abstract

The study aimed to analyze indigenous scientific knowledge into scientific knowledge through the STEAM approach. Interesting online learning can be done by integrating the local culture of the Plancungan Village. This research uses the Quantitative Descriptive method. Based on research at seven schools in Ponorogo found 83,3% of teachers never used the local culture because teachers know no understands the local culture of the Plancungan village in science material. Respondents were 62 students from Junior High School 1, Junior High School 2, and Junior High School 3. 37,74% of students know this local culture. The value of local culture is contained in the process of making pottery, namely character, aesthetic, historical, and environmental values. STEAM analysis, including science on the process of making pottery, requires a tool in the form of a turntable called "Perabot". This turntable is a form of Simple Plane. Simple Planes are tools that can facilitate human work. The math is in the Mechanical Advantage of the "Perabot" which can be calculated by dividing the wheel's radius by the axle's radius. Engineering on the body has the greatest ratio of volume to overall proportion. The moth is smaller than the neck, which is adapted to its function. Traditional pottery-burning technology uses a field stove with husk, straw, and bamboo as fuel. The art of pottery can be seen in form, color, and function. STEAM analysis on the pottery-making process can increase students' interest in science. The student's interest in learning science obtained an average N-gain of 0.70 with high criteria. The resulting STEAM analysis can also be applied to e-modules, e-learning, e-books, etc.

Keywords: Analysis, STEAM, Interest, Science Learning

INTRODUCTION

Learning sciences is not only about facts, concepts, and principles but also about finding something out. In 2020, learning sciences was held online because of pandemic Covid19. To gain the students learning motivation, teachers have to teach creatively. Therefore the students easily understand the subject of the sciences (Faorika et al., 2021). Not only teaching creatively but learning purposes that have been drafted should also be reached by the teacher. Compiling simple material and creative thinking to design learning with experimental activity is also challenging for teachers (Sriyansyah & Anwar, 2021). In fact, seven junior high schools in the Ponorogo district use assignment for learning activities. Three respondents use Lecturing Method, two use Problem-Based Learning, while the others use Scientific 5M and Project Based Learning. The effectiveness of online learning can be rated from 1 to 10. There are (42,9%) respondents who asses 4, and there are (14,3%) respondents who asses 2, 5, 6, and 7 for the effectiveness of online learning. Some supporting and inhibiting factors in learning activity are facilities or tools, internet networks, student motivation, and supporting parents (Handayani & Jumadi, 2021).

Student learning interests possess essential rules for success in learning. Interest in learning also shows interest in a lesson (Hidayat et al., 2018). Studies in Germany show that female students are highly interested in learning Art and Social in sciences (Dierks et al., 2016). Analysis of students learning interests in VII, VIII, and IX classes at Junior High School in Gianyar obtained middle category (55,08%) (Pujani et al., 2023). While at Junior High School in Bengkulu obtained high category (53%), middle category (39%), and low category (8%) for students in IX class (Rondoni et al., 2022). A similar result was also found at Junior High School in Ponorogo. Student learning interest obtained 62,6%. Based on the previous result, student learning interest in the sciences program should be enhanced in the online learning program.

The online learning sciences program's environmental utilization for learning resources is one innovation. Utilizing local culture for learning can attract students learning interest. Utilizing local culture for teaching content improves knowledge and can increase nationalism and pride in regional potential (Adinugraha, 2016). The pottery industry is a local culture in the Plancungan village that still exists nowadays. Based on the truth, 83,3% of teachers that teach the sciences program at the junior high level at Ponorogo districts have not utilized the local culture in the Plancungan village for learning resources. Most of the science program teachers have not understood scientific science in the pottery-making process in Plancungan village. Based on the survey, 62 students in IX class at Junior High School 1, Junior High School 2, and Junior High School 3 in Ponorogo, West Java only understand (37,74%) information about the local culture in the Plancungan village.

The learning approach that is appropriate for online learning is STEAM. Implementing STEAM in the learning process effectively expands cognitive, affective, and psychomotor abilities. Utilizing the STEAM approach in the learning process supports modern learning with the digital platform. Therefore it gains the student's learning interest (Milara et al., 2020). Flipped classroom model is a platform application based on the STEAM approach that significantly increases the students' interpersonal knowledge and concept mastery during the online learning process (Albar et al., 2021). Furthermore, utilizing the STEAM approach during online lectures for Biology students has shown a good impact (Zb et al., 2021). Moreover, the STEAM approach is also used for the Project Based Learning model. It has significantly increased the student's critical thinking during online learning at Vocational School in Malang Grade X AK (Cahyani & Sulastri, 2021). Informally short practical of utilizing a module that combines Art with STEM and turns into STEAM has generated creative learning in the cognitive area (Thuneberg et al., 2018). The student's creativity can be trained using Project Based Learning model. In the new normal after the pandemic covid19, the learning process

focuses on hybrid learning. This research analyzes STEAM in making pottery to increase students' interest in the sciences program.

METHOD

The research method uses quantitative-descriptive. The quantitative-descriptive method aims to express thing as they are (Putra, 2015). Descriptive research is done by searching for information, describing goals, and collecting data. While quantitative research is used because the data is in the form of numbers from collecting, interpretation, and research results used numbers (Jayusman & Shavab, 2020). Furthermore, the descriptive method is also used to explain data obtained in detail. While the quantitative approach in this research also aims to construct the data obtained properly in being presented (Almuharomah & Mayasari, 2018).

The population for collecting data is the students of one of Madrasah Tsanawiyah in Ponorogo grade IX. The sample uses 17 students of C class grade IX. This research was held from April to May. The technique of collecting data used interviews, dissemination of questionnaires of student learning interest in learning sciences with an integrated STEAM approach to local culture, and direct observation of the craftsman pottery in the Plancungan village. The STEAM learning implementation in school was conducted through a learning project as a learning model.

RESULTS AND DISCUSSION

At The local cultural value contains in the process of making pottery in the Plancungan village, Slahung sub-district, Ponorogo regency

The value can be described in Table 1.

Table. 1 Local Culture Value in Process Making Pottery

Value	Description
Characteristic value	The process of making pottery always emphasizes focus, creativity, and patience, those things are reflected in every step of making pottery, making clay into jug, *lepak*, and glass.
Cultural value	The craftsmen of pottery in the Plancungan village have a high motivation to work though they are no longer young. The high motivation should be exemplified by the millennial generation.
Aesthetic value	The pottery product that done to make has two colors, red and black. The red color was produced by the burning process without *Trembesi leaves*, while the black color was produced by the burning process with the *Trembesi leaves.*
Historical value	Based on the story, the pottery craft in the Plancungan village is the heritage of Mataraman. The founder of the Plancungan village was descent from *Bayat* West Java. Moreover, the founder has been taught about well-being through pottery craft.
Environmental value	As known, people in the modern era like to use tools from plastics. Plastics constitute the largest garbage in Indonesia and it is tough to compose by soil. By using pottery crafts like jugs, plates, and

Value	Description
	glass for house tools, it can reduce the use of plastics. Because the pottery craft is used from the soil, it can be easy to compose in a short time.

STEAM analysis in the process of making pottery in the Plancungan village, Slahung sub-district, Ponorogo regency

Table 2 is the basic definition of STEAM.

Table. 2 STEAM Analysis

STEAM Aspects	Description
Science	1. The The pottery wheel for making pottery craft is used as a simple machine principle. A simple machine is a tool for facilitating a human's job. In the physics material, six simple machines have been discussed, lever, pulley, wheel, axle, inclined plane, screw, and wedge. Each part of the simple machine facilitates convenience for human life (Iman et al., 2017). 2. Pottery is a product that composes of soil. In the process of making pottery, the soil should be dried and after that, the soil should be crushed by the water. Single and mixed substances are materials classified as chemicals in secondary school (Nisa, 2017). The chemical properties of soil are defined as the overall chemical reactions that take place between soil constituents and between soil constituents and materials added in the form of fertilizers or other soil improvers (Bahri et al., 2016). In common reactions that occur in the soil are affected by certain environmental factors. 3. In the process of burning pottery, temperature, and heat were used to produce high-quality pottery. Burning is one of the techniques that is widely used. Studies about the burning technique lead to the fluid mechanic that produces chemical reactions that release a certain amount of heat. The amount of heat that is released by a chemical reaction is defined as an aspect of simple thermodynamics. It caused a quick reaction. This approach can be done if the burning process is stationary combustion (Vinasse et al., 2014). 4. Pottery product is a recycled product because of the soil material and it does not pollute the environment. Green product can be implemented because it does not pollute the environment and recycle material (Ferry Wibowo, 2011).
Technology	1. *Perabot* was made simply and used simple material and economic values. This *Perabot* is moved by rotating so that it can produce various forms of pottery. The technology of *Perabot* that exist nowadays used welding machine. By using the pottery wheel, the product of pottery can increase production volume (Imam, 2019). 2. The burning of pottery was used by making a huge stove of clay. The stove should be perforated so that a burning fire spread and make the pottery a red color. Burning pottery using traditional techniques is still used for making pottery in the Plancungan

STEAM Aspects	Description
	village. Furthermore, the technique of burning pottery can be used to reserve the furnace. This furnace produces bursts of fire not hitting objects directly but rotating. The heat travels towards the different chambers, rotates through the lower chambers, then into a two-meter-long canal, then out into a 7-meter-high chimney (Soebroto, 2019).
Engineering	1. Drafting technique of *Perabot* *Perabot* is arranged by combining wooden boards and wooden bases whose shafts are given a horn so that wooden boards can rotate. The preparation of furniture can be seen as follows:  2. Drafting technique of kiln The place of burning pottery or kiln is arranged by brick that is arranged like a stage and forms like a tube.   3. There are three techniques for drafting pottery: a) Lip (mouth) In some jugs, this part is smaller than the neck, or sometimes wider with a cap. The diameter of the mouth of the jug is mostly adjusted to its function of pouring water on the tip of the mouth or lips. b) Neck (neck). One of the main functions of the neck of the jug is as a handle to lift or move the jug when pouring water. The narrow neck of the jug is useful to prevent water from spilling when carried and to control pouring. c) Belly (body): This part has the largest volume ratio of the overall proportion of the jug. This part serves as a water storage container. In general, the shape is globular with little variation.
Mathematics	1. Calculation of *Perabot* size. This piece of *perabot* applies the working principle of the Pivoted Wheel. A pivoted wheel is a simple machine consisting of a rotating wheel that is connected by a shaft and they rotate simultaneously. Wheels and shafts are simple machines that function to magnify speed and force. Bicycles are examples of tools that work using the principle of wheels and shafts. The function of wheels and shafts is to allow humans to move faster. The mechanical advantage of axled wheels can be calculated using the following equation: KM = $\frac{Jari-Jari\ Roda}{Jari-jari\ Poros}$ 2. Calculation of pottery kilns. To know if the kiln can accommodate the pottery in the largest amount, people need to analyze the shape and size of the kiln. The diameter of the upper kiln should be made larger than the lower kiln. The kiln should be coated with iron so the top of the kiln does not collapse.
Art	1. *Kendi* (a drinking container) A drinking container or commonly known as a jug has a round shape on the body, the mouth part shrinks, the handrail part is

STEAM Aspects	Description
	small, and the top of the *kendil* is open, this part is used to pour water into the jug. This shape is still preserved so that it is a continuation of the basic shape of the jug. *Kendi* is still used in traditional Javanese bridal ceremonies in *panggih* processions. In the traditional ceremony, *kendi* has additionally decorated in good shape. 2. *Kendil* (used for mbudak ceremonies) *Kendil* has been used since ancient times. Currently, *kendil* can be found at the traditional mbubak ceremony. The shape of *kendil* is smaller than the jug and has a lid on it. 3. Pottery coloring Pottery coloring uses *trembesi* leaves for shining and dark looks. Bright red pottery is produced by burning without adding *trembesi* leaves. Pottery coloring developed to be more diverse according to the demands of the times. Model pottery now uses colorful paint so that it looks more beautiful. 4. Additional decorative elements Additional decorations have been used since the 1980s, but there are only some craftsmen can apply these decorations. Pottery that is given additional decoration usually requires a long time and requires extra patience.

Implementation of STEAM learning at one of Madrasah Tsanawiyah in Ponorogo

Learning based on the STEAM approach is conducted during the new normal period, which applies face-to-face 50%. Students of C class grade IX were used as research samples. The implementation of learning uses a project-based learning model. STEAM analysis on the pottery-making process was applied to group-based learning, and this group had to design the automatic pottery wheel prototype with available materials such as a dynamo kite, cables, batteries, and paperboard. The tools and the materials are arranged so that when connected to a cardboard battery, they can rotate automatically.

The interest of students who received demonstrations with prototypes increased to acquire technical skills and understand the application of concepts (Dhivvya et al., 2020). Projects that start from classroom practice allow students to learn and practice making functional devices by directly applying physics, programming, and electronics (Imbachi-Diaz et al., 2023). Prototype, construction, and evaluation contributed significantly to understanding the manufacture, impact of the design used, and integration guidelines (Radu et al., 2023). Specifically, the smaller the difference between an individual's prototype and self-image, the stronger their sense of concern for the subject (Hannover & Kessels, 2004). The prototype manufacturing approach can be used to improve the knowledge of technology, techniques, and business activities (Beck et al., 2006).

STEAM also brings out different and unexpected works from each individual or group. In addition, collaboration, cooperation, and communication will appear in the learning process because this approach is done in groups (Herlina et al., 2022). These things happen because, in the learning process with the STEAM approach, students are asked to explain their products based on STEAM aspects. The results of the science project this pottery wheel apply the principle of a simple machine of axle wheel. Mathematics in the form of mechanical advantages of pivoted wheels can be calculated by dividing between the wheel spokes (round paper) and the shaft radius (tip of the dynamo). This simple technology in making an automatic pottery wheel uses a power source of a 1.5V battery. To rotate a pottery wheel, connect the paper to the Dinamo haft, arrange two batteries in place, and then connect the battery holder cable with the dynamo cable. Each of the pottery wheels has to design differently from the other group.

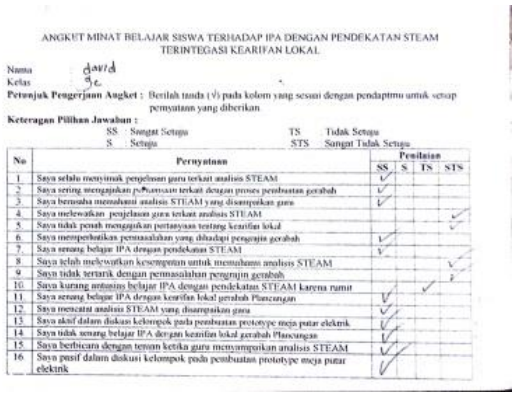
The STEAM integrated by PjBL can increase and develop students' creative thinking skills (Hendriyani et al., 2023). Integrating STEAM by PjBL into science learning encourages students to connect science knowledge in everyday life, develop curiosity, and increase problem-solving skills (Adriyawati et al., 2020). In line with the research, the project-based STEAM approach brings out real-life positive aspects related to chemistry (Domenici, 2022). The STEAM integrated by PjBL affords to improve science skills (Badriyah et al., 2020) (Badriyah et al., 2020). Moreover, the social development of children can be seen in the process of making products (Harjanty & Muzdalifah, 2022). Therefore, it can be concluded that the PjBL-based STEAM approach influences the students learning interest in science programs (Chistyakov et al., 2023).

STEAM impacts thinking and creative abilities, producing innovative learning or media (Ahmad et al., 2021). The STEAM approach aims to increase students' knowledge of the practical theory learned in school (Anisimova et al., 2020). So that STEAM as a learning process is designed to integrate concepts into meaningful constructions (Belbase et al., 2022). The particularly demonstrated experience has shown the student interaction to discover, maintain, and develop the student learning interest (Neher Asylbekov & Wagner, 2023). STEAM supports meaningful learning experiences, problem-solving, and science, technology, engineering, art, and math are connected in STEAM (Asril et al., 2022). The technical STEAM approach also participates creatively toward a sustainable society (Skowronek et al., 2022). Both STEM and STEAM have interventions centered on one's creativity (Aguilera & Ortiz-Revilla, 2021). So that learning can increase student academic achievement (Polmart & Nuangchalerm, 2023). Improving science learning can also be done by integrating local culture.

Science learning that contains local culture can increase students' interest in local culture so that the learning process can be more contextual and meaningful) (Setianingrum et al., 2023). The seasonal calendar based on the local culture of the Gorontalo people is expected to be used in science learning (Tamu & Dako, 2018). The integration of local culture into science learning is expected to be practiced to follow the culture of the Indonesian nation(Astawan et al., 2019). In line with this research, Ugahari local culture in Malaysia plays a significant role to form individual work and family life (Kusairi et al., 2022). Integrating local culture can be a solution for groups to differentiate (Saenprai et al., 2023). Applying local culture in Schools can be done by synthesizing local culture (Pornpimon et al., 2014). The integration of pottery local culture in science learning can be done through instrument assessment (Almuharomah et al., 2023).

The direct experience that students receive from both cognitive and psychomotor aspects can encourage students' learning interest in science. Teachers should provide creative learning in the science program. For example, tea chers have to combine Lecturing Method and interactive videos during the learning process to attract the students' learning interest (Mursabdo, 2021). The STEAM approach facilitates students to find answers independently, making the learning process more active and student-centered. This method can attract the students' interest in physics (Slameto, 2015). Here is the activity documentation:

Figure 1.Student Activity Sheet



ANGKET MINAT BELAJAR SISWA TERHADAP IPA DENGAN PENDEKATAN STEAM TERINTEGASI KEARIFAN LOKAL

Nama : David
Kelas : 9c

Petunjuk Pengerjaan Angket : Berilah tanda (√) pada kolom yang sesuai dengan pendapatmu untuk setiap pernyataan yang diberikan

Keterangan Pilihan Jawaban :
SS Sangat Setuju TS Tidak Setuju
S Setuju STS Sangat Tidak Setuju

No	Pernyataan	Penilaian			
		SS	S	TS	STS
1	Saya selalu menyimak penjelasan guru terkait analisis STEAM	√			
2	Saya sering mengajukan pertanyaan terkait dengan proses pembuatan gerabah	√			
3	Saya bersemangat memahami analisis STEAM yang disampaikan guru	√			
4	Saya melewatkan penjelasan guru terkait analisis STEAM				√
5	Saya tidak pernah mengajukan pertanyaan tentang kearifan lokal				√
6	Saya memperhatikan permasalahan yang dihadapi pengrajin gerabah	√			
7	Saya senang belajar IPA dengan pendekatan STEAM	√			
8	Saya lelah melewatkan kesempatan untuk memahami analisis STEAM				√
9	Saya tidak tertarik dengan permasalahan pengrajin gerabah				?
10	Saya kurang antusias belajar IPA dengan pendekatan STEAM karena rumit			√	
11	Saya senang belajar IPA dengan kearifan lokal gerabah Plancungan	√			
12	Saya mencatat analisis STEAM yang disampaikan guru	√			
13	Saya aktif dalam diskusi kelompok pada pembuatan prototype meja putar elektrik	√			
14	Saya tidak senang belajar IPA dengan kearifan lokal gerabah Plancungan	√			
15	Saya berbicara dengan teman ketika guru menyampaikan analisis STEAM	√			
16	Saya pasif dalam diskusi kelompok pada pembuatan prototype meja putar elektrik	√			

Figure 2. Student Learning Interest Questionnaire

The implementation of STEAM can increase student interest in learning science. The student learning interest in the science program is measured by questionnaires that have been validated by two panelists or science teachers. A description of the validation result can be seen in Table 3.

Table 3. The Validation Result of Student Learning Interest in Science with an Integrated STEAM Approach to Lokal Wisdom:

Components of the Questionnaire Assessment	Content Validity (CV)	Category
Suitability of statements with indicators	0,875	Very high validity
Clarity of language used	0,705	High validity
Eligibility of statements referring to the purpose	0,777	High validity

The validity of content, according to (Gregory, 2007), if it is more than 0.7, fulfills the requirements and can be continued for the next steps. This also shows that the instrument is relevant for measuring the variables under study (Tomoliyus & Aryanto, 2020). The content validity refers to Gregory, (2007) content validity criteria. The success of environmental education is closely related to interest in nature which can be assessed with new technology (Kleespies et al., 2021). The development of computer-based learning interest assessments provides tremendous possibilities for conducting surveys authentically (Krapp & Prenzel, 2011). Teaching practices unsuitable for student learning interests will affect students' academic outcomes (Boukayoua et al., 2021). There is a correlation between students' interests, attitudes, and science skills in science subjects (Ernawati et al., 2022). There is an influence between interest in learning science and learning methods on power and energy materials (Hasanati & Purwaningsih, 2021). So students' learning interests need to be analyzed to improve the learning process.

The questionnaire on students' interest in learning science was developed using the 4-point Likert Scale. The results can be seen in Table 4.

Table 4. Results of Student Learning Interest in Science with an Integrated STEAM Approach to local culture

Indicator of learning interest	N-gain	Criteria
Attention	0,950	High
Interested	1	High
Pleasure	0,362	Medium
Engagement	0,514	Medium

The indicator of learning interest refers to (Ricardo & Meilani, 2017), and the N-gain category refers to (Dwiantara & Masi, 2016). Based on Table 4, an average N-gain of 0.705 is obtained with high criteria. The integrated STEAM of local culture can increase students' interest in science learning. This is following the STEAM-PjBL approach, which can increase students learning interest, students learning interest in chemistry programs are high category (83,4%) (Suryaningsih et al., 2022). Student learning significantly impacts the mastery of

science concepts of junior high school students in Tangerang City (Astuti, 2017). The results also show that discovery, continuous engagement, and interest development lead students to learn (Ramey & Stevens, 2019). Male students in various countries are more interested in science, science work, and activities related to science and technology (van Griethuijsen et al., 2015). The findings show that the higher students' interest in learning science, the higher the results of learning science online (Wiradarma et al., 2021). In addition, students' interest in learning science lessons outside of school can be demonstrated through individual learning environments (Neher Asylbekov & Wagner, 2023)

Student interest in learning the science of attention indicator involves attention to the teacher's explanation and the courage to ask questions. Indicators of interest relate to students' efforts to understand the teacher's explanation. The pleasure of learning science with STEAM is related to the loss of laziness because the assumption of learning science integrated with STEAM's approach to local culture is complicated. Student interest in learning science on the Engagement indicator is related to students' efforts to be directly involved in learning, such as paying close attention, recording important things from the teacher's explanation, being active in discussion activities, and completing assignments. This is in line with indicators of interest in learning, which include feelings of interest and pleasure to learn, active participation, a tendency to pay attention and great concentration, positive feelings and an increasing willingness to learn, comfort when learning, and the capacity to make decisions related to the learning process (Ricardo & Meilani, 2017). The contribution of initial knowledge of one of the other external variables is interesting in learning, attention to learning, learning motivation, and knowledge.

Students learning interest is inseparable from the supporting factors. The external factors are from the character subjects such as mathematics. The external factors of science learning interest can be seen in leisure activities such as reading about science and visiting science centers (Jocz et al., 2014). The findings show a cause and effect between students' science concepts and interest in learning science at school (Cheung, 2017). Based on the fact that several internal factors, such as low motivation, low intelligence capacity, and sensory disorders, cause the low interest of students in learning science in Banjar Baru Regency. External factors cause low interest in learning, such as family, neighborhood, and playmates (Aditya Hartini & Siti Faridah, 2022).

CONCLUSION

The value of local culture is contained in the process of making pottery, namely character, aesthetic, historical, and environmental values. STEAM analysis, including science on the process of making pottery, requires a tool in the form of a turntable called "Perabot". This turntable is a form of Simple Plane. Simple Planes are tools that can facilitate human work. The math is in the Mechanical Advantage of the "Perabot" which can be calculated by dividing the wheel's radius by the axle's radius. Engineering on the body has the greatest ratio of volume to overall proportion. The moth is smaller than the neck, which is adapted to its function. Traditional pottery-burning technology uses a field stove with husk, straw, and bamboo as fuel. The art of pottery can be seen in form, color, and function. The resulting STEAM analysis can be applied to e-modules, e-learning, e-books, etc.

STEAM analysis on the pottery-making process can increase students' interest in science. The student Interest in learning science obtained an average N-gain of 0.70 with high criteria on each indicator. The instrument of learning interest is expected to be implemented in other junior high schools to determine the student learning interest so that the student learning interest can increase the quality of science learning.

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