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Literature Review: Inquiry Social Complexity-STEAM Model Based on Math Trail-Virtual Reality Activity Nuanced with Javanese Culture in Improving Critical Thinking Ability

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ABSTRACT

Purpose of the study: Analyze various literature studies on the Inquiry Social Complexity-STEAM model based on Math Trail-Virtual Reality activities with Javanese cultural nuances in improving students' critical thinking skills.

Methodology: This research method uses a literature review. Researchers look for data from books, journals, or relevant research articles and include them in the findings and discussion section to reach a conclusion. This research uses descriptive qualitative data analysis techniques to study literature by describing the results of sources obtained either through books, journals, or related research articles.

Main Findings: The syntax of inquiry social complexity STEAM learning model based on math trail virtual reality activities with Javanese cultural nuances can be concluded that each syntax encourages students to find, investigate, construct, and integrate the knowledge gained to form better critical thinking skills by accommodating all aspects of students' abilities with different levels to participate in every aspect and step of learning.

Novelty/Originality of this study: The addition of the STEAM approach, especially in the Inquiry Social Complexity Learning model, and math trail-based activities using virtual reality technology that has never been done before or integrated into a maths classroom.

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1. INTRODUCTION

The 21st-century learning system requires schools to shift from teacher-centred to student-centred learning to foster critical thinking skills in the era of disruption [1]. In accordance with Law 20 of 2003, students are required to actively develop themselves according to their potential to be useful in society. However, this demand may no longer be relevant to the current learning paradigm that emphasizes cognitive understanding. It is expected that students can learn faster and gain more knowledge through direct experience, resulting in a more complex understanding of the subject matter.

One essential skill for 21st-century students is critical thinking. For instance, the International Trends in International Mathematics and Science Study (TIMSS) measured students' critical thinking skills through high-level cognitive questions. The results indicate that Indonesian students' critical thinking skills are still low. According to TIMSS data, Indonesian students have consistently ranked towards the bottom of the list in

international assessments. Specifically, they ranked 35th out of 46 countries in TIMSS 2003, 36th out of 49 countries in TIMSS 2007, 38th out of 42 countries in TIMSS 2011, and 44th out of 49 countries in TIMSS 2015. [2]. Therefore, it is important to develop critical thinking skills. This is consistent with the idea that teachers should facilitate students' development of critical thinking skills through a learning process that enhances these skills, for example, students can demonstrate problem-solving skills by explaining solutions in their own words. [3]. Critical thinking skills are crucial in education, particularly during the learning process, as they enable students to gain a deep understanding of complex information. This aligns with the notion that critical thinking skills enhance students' ability to comprehend complex concepts, identify solutions, draw conclusions, and generate new ideas when solving mathematical problems [4].

To address the issue of students' critical thinking skills not being adequately met, it is recommended to implement an innovative learning model. One such model is the inquiry learning model, which allows students to develop their critical thinking skills by exploring mathematical problems and making their own discoveries. The inquiry model focuses on the stages of learning to solve a mathematical problem, starting from the exploration stage, concept introduction, to the concept application stage. This approach aims to develop students' critical thinking skills through a series of learning activities [5].

The inquiry model is designed for students who are already prepared for the learning process. Therefore, students with lower abilities may encounter challenges during their learning journey [6]. Shortcomings in inquiry learning can be overcome by integrating other appropriate learning elements. One such element is social complexity, which allows students to develop affectively by observing the behaviour of others. The hope is to facilitate the equalisation of students' abilities in the process of implementing learning with inquiry models. This statement aligns with the idea that social complexity aids in the sharing process among individuals engaged in collaborative and elaborative activities. This, in turn, fosters the development of communication skills and cognitive abilities, including critical thinking, through social interactions that occur during the learning process [7]. In addition, this is also supported by Bergman and Beehner who state that the social complexity model of inquiry provides opportunities and shapes knowledge and understanding of what is learned, discovered and achieved in the learning process so that students' critical thinking skills can be properly developed [8].

The inquiry learning model not only integrates social complexity elements, but also adds STEAM elements. The inquiry learning model integrates elements of social complexity and STEAM innovations to enhance students' potential for better mathematical critical thinking. The statement supports the idea that the development of STEAM learning aims to enhance students' mathematical critical thinking skills and encourage them to engage in argumentation [9]. This is supported by the statement that STEAM learning is suitable for the inquiry learning model because it accommodates children's ability to think critically, especially in mathematics. [10].

Improving critical thinking skills and integrating the appropriate learning model should be accompanied by a learning process that develops the potential and skills of 21st-century students. The math trail activity is a mathematical exercise that links real-world contexts to the surrounding learning environment, creating a unique atmosphere for students to enhance their mathematical knowledge. Learning mathematics through math trail activities can enhance students' ability to generate creative ideas while solving non-routine mathematical problems, demonstrating their strong critical thinking skills. This is because math trail activities encourage students to apply mathematical concepts to real-world problems, fostering creativity, innovation, and critical thinking [11].

The Math Trails activity should be supported by a learning technology component. Additionally, an ethnomathematics learning context, specifically with virtual reality technology and Javanese cultural nuances, should be added. Research supports this approach, as it has been shown that students' critical thinking skills improve significantly through teaching and learning activities that involve manipulating objects in a virtual world that is similar to the real world [12]. Other research supports the idea that the use of virtual reality in the learning process can significantly enhance students' critical thinking skills [13]. Another component that can be integrated into the process of improving critical thinking skills is ethnomathematics, specifically Javanese cultural nuances. The integration of Javanese nuances is highly beneficial in improving students' critical thinking skills. This is supported by the notion that ethnomathematics can assist students in demonstrating effective mathematical processes and communicating mathematical ideas, thereby enabling students to become critical and reflective members of society [14]. Based on the background, the researcher tries to examine the theoretical study of the Inquiry Social Complexity-STEAM model based on Javanese cultural nuanced math trail-virtual reality activities in improving critical thinking skills.

This study aims to examine the Inquiry Social Complexity-STEAM model by reviewing relevant literature. Critical thinking is a crucial skill in the 21st century. This skill is closely related to logical and rational thinking, reflection, and systematic analysis and evaluation of information to make appropriate decisions and beliefs. Individuals have different ways of thinking and generating new ideas. Socializing in an environment that encourages critical and innovative thinking can help achieve this.

The significance of critical thinking skills in students is often underestimated. However, it is important to note that teachers may not always be able to fully develop these skills during the learning process. Although the teacher has implemented technology-based learning, the learning process still relies heavily on PowerPoint presentations and discussions. However, tasks and exercises, which are the final stage of the learning process, have not been optimally utilized to empower students' critical thinking skills.

Furthermore, regarding learning with the inquiry model, the teacher has implemented it effectively. However, there has been no attempt to actively engage students in the process, resulting in limited socialisation during problem-solving and critical expression of opinions. Therefore, there is a need for an innovative learning model that emphasises effective communication to accommodate students in an active and effective learning process. One such model is the Inquiry Social Complexity-STEAM learning model, which is based on Javanese cultural nuanced math trail-virtual reality activities to improve critical thinking skills.

This innovation is based on several previous research journals that underlie the novelty of this study. The first research paper is entitled "Hubungan Kemampuan Berpikir Kritis dengan *Self Confidence* Siswa Kelas IX Materi Bangun Ruang Sisi Lengkung" [15], which examines the increase in a student's mathematical critical thinking ability. However, it does not integrate the Inquiry Social Complexity model with the STEAM learning approach, the use of Math Trails, or the migration of ethnomathematics nuances. The second research paper is titled "*The Effectiveness of Inquiry Social Complexity to Improving Critical and Creative Thinking Skills of Senior High School Students*" [16]. However, this article also has not integrated the Inquiry Social Complexity (ISC) model with the addition of the STEAM approach in it as a 21st-century learning approach. Furthermore, the research entitled "*Learning Cultural Mathematics (Ethnomathematics) Assisted by the Math City Map Application to Improve Students' Critical Thinking Ability*." [17], the researcher refers to the journal due to similarities in research objectives. Specifically, the aim is to investigate the extent to which a student's mathematical critical thinking ability can be improved by integrating the link between mathematics and culture (ethnomathematics) through the implementation of math trail activities, such as the use of the Math City Map application. However, this research also has differences. Specifically, the researcher will provide innovations by integrating Math Trail-based applications with virtual reality technology.

Based on the three journals obtained and the facts in the field regarding learning mathematics in schools with inquiry social complexity models, there are similarities. These include examining critical thinking skills using the same learning model and integrating learning innovations. Researchers will be using the inquiry social complexity model, but they are adding a novelty by incorporating a STEAM approach. Additionally, math trail-based activities will be enhanced with virtual reality technology, which has never been done before or integrated into a mathematics lesson.

2. RESEARCH METHOD

The research methodology used in this study is literature review. Researchers collect data from books, journals or relevant research articles on the inquiry social complexity-STEAM learning model, math trail, critical thinking skills, ethnomathematics, various learning theories and development theories on the inquiry social complexity STEAM model based on math trail virtual reality activities with Javanese cultural nuances in improving critical thinking skills and attached to the results and discussion section so as to produce a conclusion. The data sources for this literature review were obtained from previous research articles. The articles were then filtered to obtain relevant information related to the topic under study. A content analysis process was carried out to derive accurate discussion results and conclusions. This research employs descriptive qualitative data analysis techniques to study literature by describing the results of sources obtained from books, journals, or related research articles.

3. RESULTS AND DICUSSION

3.1. Learning Model Social Complexity Inquiry-STEAM (ISC-STEAM)

The concept of an inquiry model is based on learning theories, including the theory of social complexity. Ontologically, the model is developed by considering the patterns of interrelationship of learning to correspond with expectations and reality in learning achievement. A picture of conceptual thinking obtained from literary studies is presented [16].

Model of Inquiry	Discovery Learning	Interactive Demonstration	Inquiry Lesson	Inquiry Laboratory	Real-Word Application	Hypothetical Inquiry
Level Of Student Skills	Rudimentary Skills	Basic Skills	Intermediate Skills	Integrated Skills	Culminating Skills	Advanced Skills
S I N T A X	Observation Manipulation Generalization Verification Application					
Level of Kognitif	Low	Intellectual Sophistication				High
Teaching Activity	Teacher	Locus of Control				Student
Level of Social Complexity	Deep	Intermediate				Shadow

Figure 1. Review literature level of inquiry, level of cognitive, teaching activity and level of social complexity

Figure 1 illustrates that the element of social complexity is weak at all levels of inquiry. Therefore, it is necessary to incorporate the element of social complexity in the learning process using the Inquiry model. This is because the social element is crucial in empowering students from low to high levels, both cognitively and in terms of their skills [18]. The development of social abilities should be driven by learning innovation, as it is not necessarily consistent with the cognitive abilities and skills of students. One example of such innovation is the STEAM learning process. STEAM teaching has a unique advantage in the learning process as it facilitates socialization and discussion with the surrounding environment, leading to the development of cognitive abilities and the creation of new ideas through information exchange. This aligns with the notion that effective communication among students, as they exchange information, facilitates their thinking process, leading to the ability to generate new ideas when solving mathematical problems [19].

The Inquiry Social Complexity (ISC) model is a development of the inquiry model that incorporates elements of social complexity and is modified to the conceptual ISC. The implementation of social complexities in learning is expected to enhance various learning capabilities of the 21st century, as outlined in the activity plan in Figure 2.

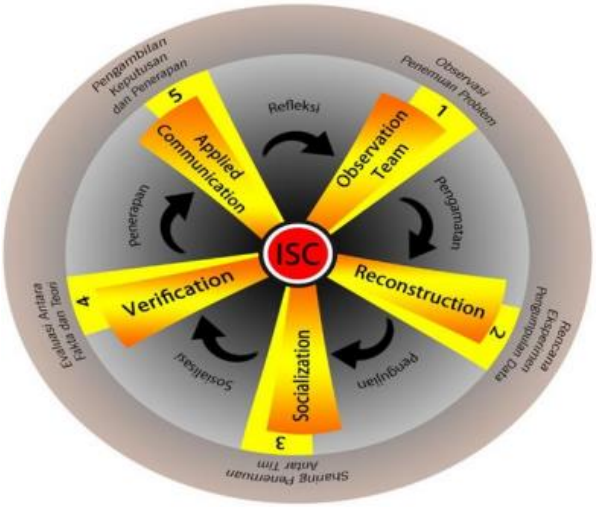

Figure 2. Syntax Inquiry Social Complexity (ISC) Learning Model

The Inquiry Social Complexity model has been designed to integrate STEAM elements, modifying the phase into five steps. These steps apply the elements of science, technology, engineering, art, and mathematics. The ISC-STEAM model follows a sequence of five steps for learning, based on the results of the inquiry phase study of social complexity and the modification of the STEAM element. These steps are carried out gradually through the learning process.

Table 1. ISC-STEAM Learning Model Step

Step	Learning Activity Plan
Observation Team	Students engage in a team discussion process to observe phenomena presented by the teacher through video or event demonstrations related to the intersections of science and art. This process aims to identify problems to investigate and study.
Reconstruction	Students in each team create ideas and collect data from various sources either through journals or related books through search activities on media such as, google and so on (*technology integration*), both qualitatively and quantitatively (*engineering integration*).
Socialization	During group discussions, students share ideas and data with each other. One member stays while the others search for results from other groups through sharing presented by another group. The presenting group then explains their findings to the member's original group. It is important for each student to actively participate in the discussion.
Verification	Students in the team test and analyze the truth of the facts of what they find by linking them to the theoretical foundations they have acquired from previous stages (*integrating science into the process of knowledge analysis and associating it; then integrating engineering into a process of making media presentations of discussion results*).
Applied Communication	The students in the group present their opinions either orally or in writing, through media presentations of the results of their group discussions. The teacher then provides instructions to determine the truth, which is correct for learning and can be applied in everyday life.

3.2. Math Trail

The Math Trail was introduced by Dudley Blane in 1985 by making a travel route in the heart of Melbourne as a family holiday activity [20]. The original purpose of the math trail was to popularise mathematics. However, it can now be used to apply maths in real-life situations that are genuinely possible. This allows for an authentic experience that can be applied to everyday life [21]. Math Trails are important for several reasons. They add a sense of enjoyment and challenge to studying mathematical topics, provide alternative assessments in addition to formal written assessments, and present math in a different perspective, which can stimulate students who have previously struggled with mathematics [22].

The math trail is an outdoor learning activity that follows a pre-determined route. At designated stops, students solve problems that have been created for them [11]. A person who creates a route is called a trailblazer, and the person who follows the route is called the trail walker. The activity of following a path is called trailblazing [20]. The math trail activity can be done anywhere, both indoors and outdoors as long as it gives students the freedom to explore [23]. The process of learning through a math trail, where the teacher acts as a trailblazer and the student as a trail walker, need not be limited to remote locations. Math Trails can also be conducted within the school premises and its surroundings. Therefore, the designed Math Trail makes use of the surroundings to create engaging and challenging problems to solve [20].

3.3. Virtual Reality

Virtual reality is a multimedia technology that can be an effective tool for teaching abstract concepts such as vibrations and waves in a concrete way. It creates a three-dimensional, realistic environment that engages users' senses of vision, hearing, and touch to shape a virtual world. Virtual reality technology is an interface between humans and machines that simulates natural environments, including visual, auditory, and movement cues. It accurately depicts reality while also allowing users to experience and interact with virtual environments [24].

The use of virtual reality and related technology has grown in recent years due to their benefits, which are not typically acquired through classical education. [25]. Virtual reality has significantly contributed to

education by providing students with a hands-on experience of engaging in environments or situations that are difficult to imitate in traditional teaching methods, such as lectures, slideshows, or two-dimensional videos. [26]. In addition, virtual reality can be an effective self-learning tool and allow teachers to monitor and guide students' learning processes. [27]. Virtual reality also enables students to develop cognitive skills through experiential learning, such as exposure to dangerous environments that they may encounter in real life.

3.4. Critical Thinking Skill

Critical thinking is the capacity of individuals to engage in activities that enable them to think critically [28]. Critical thinking ability is a multifaceted concept that encompasses cognitive skills and self-confidence. It can also be influenced by the teaching methods employed by educators to convey complex concepts to students. [29]. Mathematical critical thinking refers to an individual's ability to understand a problem by analysing and generating new ideas that can be developed into a coherent thought process [30]. Therefore, it can be concluded that mathematical critical thinking ability involves both cognitive and affective abilities, as well as self-confidence in understanding mathematical problems. This ability is influenced by various teaching methods and can lead to the production of new and logical ideas for each problem.

Facion outlines several indicators of mathematical critical thinking skills, including interpretation, analysis, evaluation, inference, explanation, and self-regulation [31]. Then, the indicators of mathematical critical thinking skills are also stated by [32], namely clarification, assessment, summarisation, and strategies/tactics. Therefore, this study expresses mathematical critical thinking skills through indicators of clarification, assessment, strategy, and inference/evaluation.

3.5. Ethnomathematics

According to D'Ambrosio in [33], states that linguistically, the prefix 'ethno' refers to the socio-cultural context, including language, jargon, behavioural codes, myths and symbols. The root word 'mathema' means explaining, knowing, understanding and performing activities such as coding, measuring, classifying, inferring and modelling. Finally, 'tics' comes from 'techne' and means the same as technique. Ethnomathematics can also be defined as a global description of the fusion and influence of cultures using mathematics in their applications or cultures that contain elements of mathematics [34]. In addition, in terms of ethnomathematics, it is defined as mathematics practiced among identified cultural groups, such as tribal national communities, labor groups, children of certain age groups, and professional classes or more broadly. From a research point of view, ethnomathematics is defined as the cultural anthropology of mathematics and mathematics education. [35]. Therefore, it can be concluded that ethnomathematics is a broad term that refers to the use of mathematics within a socio-cultural context. It includes elements of mathematics practiced among identified cultural groups, such as tribal and national societies, labor groups, children of certain age groups, and professional classes.

3.6. Learning Theory

Constructivism Learning Theory

Constructivist learning theory is basically a learning approach that provides opportunities for students to build their own understanding and knowledge [36]. Learning models that are based on constructivism aim to guide students in constructing their own ideas and discovering knowledge on their own [37].

Constructivist learning theory emphasises that knowledge is not seen as a truth but rather prioritises the interpretation of knowledge as a working hypothesis [38]. According to constructivist learning theory, students are encouraged to construct their own knowledge, describing how students can understand the material and put knowledge into practice [39]. This theory is suitable as the basis for implementing learning with the inquiry social complexity-STEAM model, based on Javanese cultural nuanced math trail-virtual reality activities, to improve critical thinking skills.

Learning activities in constructivist learning theory are characterised by active engagement, inquiry, problem-solving, and collaboration. This is in accordance with the learning process using the inquiry social complexity-STEAM model, which accommodates learning so that students have a broader insight related to knowledge. The learning process with the inquiry social complexity-STEAM model, which integrates math trail-virtual reality activities with Javanese cultural nuances, aligns with the constructivist learning theory. This theory emphasises the process of elaborating knowledge to form new perspectives. The implementation of the social complexity-STEAM learning model, based on Javanese cultural nuances, incorporates math trail-virtual reality activities into various learning activities. This approach is clearly oriented towards constructivist learning theory, as it involves a process of behaviour change through investigation with Javanese cultural nuanced math trail-virtual reality activities. This approach accommodates the actual level of development seen in students' problem-solving abilities, while the potential level of development appears in their ability to complete tasks through cooperation with peers.

Therefore, by providing various encouragements and utilizing the processes of problem decomposition and planning steps for solving, in accordance with the principles of constructivist learning theory, students' critical thinking skills can develop optimally.

Constructivism Social Learning Theory

Social constructivism is a theory of knowledge in sociology and communication. Knowledge and understanding of the world co-developed by individuals are assumed to be understandings of meaning developed in coordination with other human beings. Social constructivism emphasises the importance of culture and context in understanding what happens in society and building knowledge based on this understanding [40]. This is in accordance with the application of Javanese culture in the social complexity-STEAM learning model, where students with various background knowledge and skills relate a mathematical problem through a form of cultural image that connects the surrounding environment with a correct understanding to help strengthen student construction.

Furthermore, the application of Javanese culture assumes that the theory and practice of learning are not developed in a vacuum, but are shaped by the dominant cultural assumptions of the students. It is important to recognise the influence of culture on learning and teaching. Teachers should view a student's constructivist process as an initial step in forming their knowledge, taking into account their cultural and social environment. This will help identify factors that contribute to inequality in students' critical thinking skills, such as linguistic and socio-cultural differences, discrimination, and the rationale of education itself. [41]. This text describes the social complexity STEAM learning model that includes Javanese cultural nuances, Math Trails, and virtual reality activities, which aims to align various instructional components in the classroom, including instructors, peers, and aspects of the cultural environment, to facilitate the formation of knowledge and the creation of new ideas by learners.

Learning mathematics with a STEAM learning model that incorporates social complexity and Javanese cultural nuances, such as math trail-virtual reality activities, requires social elements to construct and find concepts together, ensuring their applicability in the future. The STEAM learning model, based on Javanese cultural nuances, incorporates Math Trails and virtual reality activities to promote social constructivism learning theory. The aim is for students to have learning experiences that integrate environmental and cultural interactions, in accordance with constructivist theory. [42].

Social Complexity Theory

Social complexity shapes a person's communication and cognitive abilities. The more a person interacts with others in a learning context, the more their communicative abilities develop. These abilities are the physical aspects of social relations between individuals, and knowledge developed together with others is more meaningful [43]. Social Complexity Theory posits that knowledge is socially constructed and structured, including the learning process. Learning occurs not only within the individual but also through external influences. Collaborative and interactive social activities are essential for meaningful learning [44].

Social complexity highlights the significant influence of culture and environment. This is very relevant to the social complexity-STEAM learning model based on Javanese cultural nuanced math trail-virtual reality activities in improving critical thinking skills which emphasises knowledge is a social product and learning is a social process and local cultural acculturation interactions so that knowledge gained is based on social processes that are strongly influenced by interactions with others and acculturation of surrounding cultures [45].

Social complexity can enhance one's ability to communicate effectively with the surrounding environment. Effective communication is a crucial attribute in the 21st century learning system, particularly in higher-order thinking processes such as critical thinking skills. By communicating effectively, students can express their opinions and knowledge to others, both orally and in writing, during the initial process of creating new ideas and knowledge [46]. This is supported by the statement that effective communication in learning emphasises reciprocity and collaboration with peers, as well as learning through practical application to gain knowledge more efficiently [47] and retained in cognitive memory for a longer period compared to self-generated knowledge [48].

Inquiry Social Complexity-STEAM Model Based on Math Trail-Virtual Reality Activity with Nuances of Javanese Culture Javanese Culture in Improving Critical Thinking Ability

The social complexity-STEAM learning model inquiry, based on math trail-virtual reality activities with Javanese cultural nuances, was developed to empower students' mathematical critical thinking skills. The model divides skills into several aspects, according to [49] these are analysis, inference, interpretation, explanation, self-regulation, and evaluation.

The analysis aspect is associated with the ability of students to identify a problem, or the intention of the truth of a fact of knowledge in relation between concept questions, descriptions or forms of questions that are expected to express beliefs and decisions of experience and reason, and information and opinions. The inference

aspect involves identifying and selecting elements in the Javanese cultural math trail-virtual reality activity that are necessary to form a reasoned conclusion or hypothesis during the verification stage. This is achieved by paying attention to relevant information and minimizing the consequences arising from data, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representation. The interpretation aspect is used to understand skills, express meaning, and make statements based on various experiences, situations, and event data. It also involves making decisions and converting them into procedures or criteria for problem-solving. This process is based on socialisation and analysing facts to express opinions in everyday life.

The explanation aspect is applied through the process of pouring knowledge gained based on evidence, concepts, methodologies, certain criteria in reasonable considerations and the ability to present reasons in the form of convincing arguments. The next aspect, self-regulation, is related to the awareness of monitoring one's cognition, the elements used in the thinking process and the results developed, especially in the process of improving good critical thinking skills, namely the ability to apply, analyse, evaluate and draw conclusions in the form of questions, confirmation, validation and correction. Therefore, there is a strong relationship between the aspects of explanation and self-regulation, because there is a process of pouring the knowledge gained into the steps related to the process of improving critical thinking skills. The next aspect, namely evaluation, this aspect is an aspect of assessing and expressing opinions related to the credibility of questions or other representations by assessing or describing a person's perceptions, experiences, situations, decisions, beliefs and assessing the strength and inferential relationships both in the form of application activities with other knowledge, questions, descriptions or other forms of representation.

In general, the syntax of the inquiry social complexity STEAM learning model based on math trail virtual reality activities with Javanese cultural nuances is as follows.

Table 2. ISC-STEAM syntax based on Javanese cultural nuanced math trail-virtual reality activity

Inquiry Social Complexity Steps	ISC-STEAM steps and their relationship with Math Trail Virtual Reality activities and Javanese culture
Observation Team	Students engage in a team discussion process to observe phenomena provided by the teacher in the form of videos/demonstrations of events related to aspects of science and art, to raise problems that are explored and studied through virtual reality technology-based Math Trail activities.
Reconstruction	Students in their respective teams, after going through the observation activities in the virtual reality technology-based maths trail activities, generate ideas and collect data from various sources both through journals or related books through search activities on media such as Google, virtual reality technology-based maths trail activities and so on (technology integration), both qualitatively and quantitatively. Data collection is done through the preparation of plans based on the steps of the virtual reality technology-based math trail activities and the knowledge gained by the students in groups using the agreed LMS (technology integration).
Socialization	Students in small groups express ideas between groups on the data obtained through virtual reality technology-based math trail activities and the reconstruction process that has been carried out from different sources, through this activity there is 1 member who stays then other members play a role in finding the results of other groups by sharing presented by other groups, which will then be explained again by the group to their groupmates about what the member gets from sharing other groups, each student has an important role to actively participate in the group discussion process.
Verification	Students in the team test and analyse the truth of the facts they find, linking them to the theoretical basis obtained in the previous stage (*integration of science in the process of analysing and linking knowledge; then integration of engineering in the process of media presentation of the results of the discussion*).
Applied Communication	Students in groups express their opinions using oral and written through media presentations of the results of their group

Inquiry Social Complexity Steps	ISC-STEAM steps and their relationship with Math Trail Virtual Reality activities and Javanese culture
	discussions in turn to then agree on the truth with the direction of the teacher which is correct in learning and can be applied in everyday life.

Based on the explanation of the syntax of inquiry social complexity STEAM learning model based on the activity of math trail virtual reality with Javanese cultural nuances, it can be concluded that each syntax prioritises students to find, investigate, construct and integrate the knowledge gained to form better critical thinking skills by considering all aspects of students' abilities with different levels to participate in every aspect and step of learning. This is supported by the opinion that each of the syntax of inquiry social complexity-STEAM learning by combining math trail-virtual reality activities with Javanese cultural nuances has an important role in empowering students' critical thinking skills, this is seen from the learning process that applies an effective and programmed teaching process [50]. This is supported by other opinions that the implementation of STEAM in the learning process is very important in the process of improving students' critical thinking skills and children's creativity [51]. Another supportive view is that students' critical thinking skills can be improved through the use of Math Trail activities and virtual reality in learning [52]. The incorporation of Javanese culture into the learning process is also very supportive and effective in improving students' critical thinking skills [53]. Therefore, based on various studies, the Inquiry Social Complexity STEAM learning model based on Math Trail Virtual Reality activities with Javanese cultural nuances does shape and empower the process of improving students' critical thinking skills for the better.

4. CONCLUSION

The 21st century learning system necessitates a shift from teacher-centred to student-centred learning to foster critical thinking processes. However, empirical evidence suggests that students' critical thinking skills remain deficient. To address the issue of students' lack of critical thinking skills, it is recommended to adopt an innovative learning model such as the inquiry learning model. This model combines social complexity and STEAM elements and can be integrated through math trail-virtual reality activities with Javanese cultural nuances. Each component significantly supports the implementation of learning activities with the social complexity-STEAM inquiry model. Additionally, the social complexity-STEAM inquiry model, which is based on the activity of a math trail in virtual reality with Javanese cultural nuances, is highly recommended for implementation. The model allows for the development of critical thinking skills from various perspectives. Therefore, this text discusses the inquiry social complexity-STEAM learning model, math trail activities, virtual reality, ethnomathematics, related learning theories, and the inquiry social complexity-STEAM model based on math trail-virtual reality activities with Javanese cultural nuances. The aim is to improve students' critical thinking skills. Furthermore, as critical thinking skills are crucial in the learning process, additional research could be conducted on developing media or other innovative forms based on the inquiry social complexity-STEAM model with a Javanese cultural math trail and virtual reality activities. This should prioritize an active and effective learning process.

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