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LEARNING MODEL EXPERIENTIAL-BASED ENVIRONMENTAL SOCIO-SCIENTIFIC ISSUES (ESSI) AND THEIR EFFECT ON CRITICAL AND CREATIVE THINKING SKILLS

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ABSTRACT

In the midst of the accelerating pace of change in the modern world, strengthening critical and creative thinking skills in students is important. This study aims to see (1) whether the EBESSIL learning model is effective in improving students' critical and creative thinking skills; (2) how much critical and creative thinking skills increase after using the EBESSIL learning model; (3) how practical the EBESSIL learning model is in improving critical and creative thinking skills. The research method used was quasi experiment with pretest-posttest non-equivalent control group design. The research sample consisted of 70 students taken from SMA Negeri 1 Tiga Dihaji and SMA Negeri 1 Buay Sandang Aji class X South Sumatra. Data collection on students' critical and creative thinking skills used test instruments. The instrument was tested for construct validity using LISREL with Confirmatory Factor Analysis (CFA). The data analysis technique used MANOVA test. The results showed that the average score of students' critical and creative thinking skills in the experimental group was higher. Multivariate test analysis results showed that the learning model used had a significant effect. Wilks' Lambda shows the value of F = 23.93 with a significance value of 0.001 <0.005, so Ho is rejected, thus there are differences in critical and creative thinking of students in experimental and control classes. The effect size value obtained d = 1.66 with a high category at a probability of excellence of 80%. Thus learning using the EBESSIL model in the experimental class is more effective and has a high effect on the ability of critical and creative thinking skills. From the results of this study it can be concluded that the application of the EBESSIL learning model is more effective in improving students' critical and creative thinking skills. Researchers recommend that the EBESSIL learning model can be used in high schools to improve students' critical and creative thinking skills which are still low.

Keywords: creative thinking, critical thinking, effectiveness, socio-scientific issues

INTRODUCTION

Education is a means to develop quality and competitive human resources in the era of globalization. An important factor in achieving educational goals is the learning process (Castro & Tumibay, 2021; Okoye et al., 2023; Zhang et al., 2022). The rapid development of science and technology requires every country to have expertise and skills that match the demands of the 21st century. To navigate the complexities of the modern world and compete effectively on the global stage, individuals in Indonesia must possess skill sets that match the demands of the 21st century landscape. 21st century skills should develop life skills and soft skills such as critical and creative thinking (Dilekçi & Karatay, 2023; Hirudayaraj & Matić, 2021). This makes it necessary to re-evaluate the skills that are considered important in education (Juškevičienė et al., 2021). Critical and creative thinking skills are important for improving student achievement. according to research (Mursid et al., 2022; Nacaroğlu & Bektaş., 2023), student achievement can be increased by creative

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and critical thinking skills. Therefore, information management during learning must prioritize these skills at a higher level of cognitive thinking process skills (Chee et al., 2009; Picciotto, 2007). Critical thinking is analyzing situations based on facts and evidence to obtain a conclusion. Critical thinking is vital in solving problems, explaining, and evaluating (Ennis, 2018; O'Reilly et al., 2022; Supena et al., 2021). Critical thinking requires someone to interpret, analyze, evaluate, explain, infer, and self-regulate (Facione, 2016; Terblanche & De Clercq, 2021; Wale & Bishaw, 2020). It develops and explains arguments from data arranged into a complex decision or idea (Campo et al., 2023; Seibert, 2021). By thinking critically, one can analyze data or information in a systematically arranged way based on logic in investigating data or facts (Jiang et al., 2023). In the 21st century, critical thinking skills are still relatively low and require effective learning (Janssen et al., 2019; Reynders et al., 2020; Ayçiçek.,2021). It is lacking because the learning does not focus on empowering them (Baena-Morales et al., 2023; Darmawansah et al., 2022). Lack of practice and activities for critical thinking is the cause of low students' critical thinking skills (Nacaroğlu & Bektaş, 2023), indicated by rote and memorization test questions. Students cannot solve problems because of a lack of critical thinking skills (Davies & Willing, 2023). Students memorize too much, which causes them to think less and have less conceptual understanding (Tong et al., 2023; Wang et al., 2022). If students are often trained in critical thinking activities, their skills can develop optimally (Anggraeni et al., 2023; Gao, n.d.; Silberman et al., 2021).

Besides critical thinking, teachers are also essential to improve students' creative thinking in learning (Erdoğan, 2020; Lestari et al., 2021). The ability to analyze new information and combine ideas or concepts to solve problems is known as creative thinking (La Moma, 2016;Wu & Wu, 2020). Expertise in data analysis and problem-solving demonstrates creative thinking skills. High creativity indicates that a person can think creatively (Tang et al., 2020; E. Paul Torrance, 1977). The Global Creativity Index results show low Indonesian creative thinking skills (Dewi et al., 2019; Anisa et al., 2023; Marwany et al., 2023). One of the factors for students' low creative thinking is the teacher's lack of training in this competency (Hidayat & Widjajanti, 2018; Elsayed & Al-Abbad, 2023; Zhu et al., 2023)

Critical and creative thinking skills are important to be developed and owned by students, but when preliminary study research was conducted on 124 students at State Senior High Schools in South Oku, South Sumatra province found that critical and creative thinking skills were still low. Critical thinking skills in the aspect of interpretation 44.95% with very poor criteria, analysis 40.12% with very poor criteria, evaluation 49.79% with very poor criteria, and inference 40.72% with very poor criteria. In addition to the critical thinking skills test, a creative thinking skills test was also conducted on the 124 students. The results of the test showed that the participants' creative thinking skills were still low in the aspects of problem sensitivity 58.66% with less criteria, fluency 56.65% with less criteria, flexibility 49.39% with very poor criteria, originality 44.75% with very poor criteria, and elaboration 34.27% with very poor criteria. Field findings show that students do not actively follow and understand the material presented by the teacher when the learning material is considered uninteresting. Teachers are not accustomed to measuring and developing innovative learning models, so students have difficulty exploring knowledge and developing these skills.

There is a gap between the current creative and critical thinking skills and the expected competency criteria. The problem of not fulfilling the indicators of students' creative and critical thinking skills is important for researchers to find the right solution. The solution offered is to use a new and innovative learning model. The results of previous research on efforts to improve students' low critical and creative thinking skills have been carried out. The scientific learning model was chosen by researchers and educators as an effort to improve these skills. Among them by using ethno-STEM project-based learning for high school students has been implemented with a positive impact on improving critical and creative thinking (Sumarni & Kadarwati, 2020). The Discovery Learning Model Using E-Learning on the Subject of Environmental Change this research provides information about students' critical thinking skills has increased (Minan et al., 2020), and Interprofessional inquiry-based learning (IBL) encourages the development of critical and creative thinking skills (Rodríguez et al., 2019). From the many studies conducted on critical and creative thinking skills, researchers consider it is still important to apply a new and innovative EBESSIL learning model to overcome the low level of these skills.

Therefore, researchers consider it important to present the EBESSIL learning model to improve critical and creative thinking skills. The EBESSIL model was developed based on the

main experiential model, then refined based on the characteristics of the Environmental Socio Scientific Issues (ESSI) material. The syntax of the experiential model was modified and integrated with the ESSI approach to produce a new learning model. This model provides an active and contextualised learning environment. Contextual learning can improve learning achievement (Dolnicar et al., 1997; Márquez, 2020; Yunitasari et al., 2023) where the ability to communicate ideas, the ability to analyse, conjecture, make conclusions is well developed. Therefore, this model can provide better interaction between students and teachers resulting in higher levels of student participation. The interaction occurs from various opportunities, both inside and outside the classroom. Thus, this learning model contains elements of combining scientific, contextual and social learning so that the learning carried out can build students' basic knowledge into complexity.

The EBESSIL model syntax consists of five learning syntaxes, namely orientation, reflective observation, scientific background, active experimentation, and communication. The syntax is designed to build basic to complex scientific knowledge that includes exploration, elaboration, creation and communication activities. The syntax of this model facilitates students to conduct learning activities and communicate actively by constructing theories and experiences. This learning model is designed to achieve learning objectives in improving creative and critical thinking skills through individual, group and class learning activities.

From the results of preliminary studies and review of existing literature, this research focuses on the problem of low critical and creative thinking skills at the high school level, the lack of effective use of appropriate learning modes to improve students' critical and creative thinking skills. The purpose of this study will answer (1) whether there is an increase in students' creative and critical thinking skills using the EBESSIL model; (2) how effective the EBESSIL model is in improving students' critical and creative thinking skills; (3) how practical the EBESSIL model is in improving creative and critical thinking skills.

This research is important to strengthen previous research on the urgency of effective learning models as an effort to improve higher order thinking skills. This research is an input to educators, that the learning model used must be in accordance with the paradigm of needs in learning. As an effort to improve the quality and quantity of education, the EBESSIL learning model that has been developed is used by researchers as a new breakthrough, especially in learning in improving students' critical and creative thinking skills. The use of the EBESSIL model is in accordance with the learning objectives designed by educators to assist students in understanding the material, train critical and creative thinking skills, and achieve optimal learning outcomes. The EBESSIL learning model can be utilised by educators to improve the quality of education, especially at the upper secondary education level in improving high-level skills and input for the government in addressing the effectiveness of learning in the 21st century.

METHODS

This type of research is a quasi-experiment with a pretest-posttest non-equivalent control group design (Van Elsen et al., 2023).The control group used the PBL learning model, and the experimental group used the EBESSIL learning model. Furthermore, a comparison was made whether critical and creative thinking skills were better in the control class or experimental class. The research sample used XI science class students of SMA Ogan Komering Oku Selatan Regency, South Sumatra, Indonesia. The experimental group was class X IPA 1 SMA Negeri 1 Tiga Dihaji, totalling 35 people. The control class used was class X IPA 1 SMA Negeri 1 Buay Sandang Aji which numbered 34 people. The experimental and control classes were first tested for equality using the F test. Classes are declared equal if Fcount ≤ Ftable (0.05; df1; df2). Furthermore, the Levene test was conducted to determine the homogeneity of the data.

The instrument for measuring critical and creative thinking skills was developed using Design and Development (D&D) which refers to the Ellis & Levy model. To build an empirical basis for creating new instructional products, tools, and models. This research conducted a systematic review of the process, development, and evaluation (Aldeen et al., 2014; Kwangmuang et al., 2021). The prototype of the instrument was developed based on the aspects of the grid. The content validity of the instrument was assessed by 7 expert validators and calculated using Aiken›s formula. All items fulfilled content validity because the Aiken coefficient for critical and creative thinking items was at the required level (0.76) (Harmurni, 2019). Construct validity was tested using Confirmatory Factor Analysis (CFA) using Linear Structural Model (LISREL). The sample used was high school students from

3 schools in Indonesia totalling 167 people with data collection techniques through tests given to students to determine the extent to which empirical data in the field can support the theoretical constructs that have been determined, whether the constructs have been fulfilled or the data found do not support the theoretical constructs. The results of the construct validity test using the Linear Structural Model (LISREL) with the Confirmatory Factor Analysis (CFA) value and Standardised Loading Factor (LF) on each indicator. LF is declared valid if the item meets the minimum criteria of 0.5. The results of the critical and creative thinking skills reliability test showed Composite Reliability (CR) with a value of $0.9 \geq 0.7$ on the reliability criteria. The Root Mean Square Error of Approximation (RMSEA) value in CFA shows $0.043 < 0.08$, Chi-Square $1.30 < 2$, and Goodness of fit Index (GFI) $0.95 > 0.90$. The instrument model fits the field data and can be used for measurement. The novelty in the resulting instrument lies in the results of the synthesis of critical and creative thinking skills indicators and test questions developed. The results of the synthesis of critical thinking skills and creative thinking skills in Table 1 and Table 2. Indicators of critical thinking skills are determined through researcher synthesis based on experts as presented in Table 1.

Table 1. Synthesis of Critical Thinking Skill Indicators

Ennis (1996)	Watson & Glaser (2012)	Facione (2016)	Akpur(2020)	Synthesis Result
Focus	Make inference	Interpretation	Interpretation	Identification
Reason	Deductions argument	Analysis	Analysis	Interpretation
Inference	Interperations	Evaluation	Evaluation	Analysis
Situation	Recognize assumptions	Explanation	Conclusions	Evaluation
Clarity	Evaluate	Inference	Argumentation	Explanation
		Sellf-regulation.		Self-regulation

Sources: Ennis (1996), Watson & Glaser (2012), Facione (2016), Akpur (2020)

The synthesis results in Table 1 resulted in 5 new critical thinking skills for measurement in students including: Identification, Interpretation, Analysis, Evaluation, Explanation, and Self-regulation. The synthesis of creative thinking skills can be seen in Table 2. The results of the synthesis in table 2 produce 4 aspects of creative thinking skills: Problems sensitivity, fluency, flexibility, and elaboration. This study used one-way MANOVA analysis to evaluate the effectiveness

Table 2. Synthesis of Creative Thinking Skill Indicators

Torrance(1974)	Guilford (1975)	Williem (1998)	Doron (2017)	Synthesis Result
Fluency	Problem Sensitivity	Originality	Fluency	Problem sensitivity
Flexibility	Fluency	Elaboration	Flexibility	Fluency
Originality	Flexibility	Fluency	Elaboration	Flexibility
Elaboration	Originality Elaboration	Flexibility	Problem Sensitivity	Elaboration

Sources: Torrance (1974), Guilford (1975), Williem (1998), Doron, (2017)

of the learning model. The analysis used Cohen's formula to calculate the magnitude of the effect of the application of the EBESSIL model on improving critical and creative thinking skills. To find out how much the increase in research results is done with the N-Gain test. N-Gain statistical test to determine how much the learning outcomes score increased between before and after the application of the EBESSIL model. Seeing how much the pretest and posttest results increase can be seen in the N-Gain score range table in Table 3. Then the effectiveness of the EBESSIL model is carried out with the effect size test to determine the effectiveness of the learning model that has been applied. The criteria for the effectiveness of the EBESSIL model on critical and creative thinking skills in Table 4. How much the pretest and posttest results improved can be seen in the N-Gain score range table in Table 3.

Tabel 3. Interpretation of N-gain score

Score N-Gain	Criteria
N-Gain > 0,7	High
0,3 ≤ N-Gain ≤ 0,7	Medium
N-Gain < 0,3	Low

Seeing the category of the effectiveness of the EBESSIL model, the effect size test can be seen in Table 4. The categorisation of effect size

test scores adapted from Cohen (1988) is as follows:

Tabel 4. Interpretation of Effect Size

Effect Size (ES)	Criteria
0,00 ≤ ES < 0.20	Very Low
0,21 ≤ ES < 0.50	Low
0,51 ≤ ES < 100	Medium
>100	High

RESULTS AND DISCUSSION

Descriptive analysis critical and creative thinking skills are presented in Tables 5. Findings in the implementation of learning show that students in the experimental group look more active than the control group. Student participation in the experimental group seemed more active in conducting discussions and expressing opinions. This is because the learning that is carried out is more contextual and meaningful regarding the problems that exist in the student's environment, so that students are familiar with the topics presented by the teacher. Through an approach to environmental socio-scientific issues on the topic of material presented by the teacher, students can argue, analyze and develop creative ideas.

Before the test is carried out, a prerequisite test is carried out. The normality test was carried out to see the distribution of data in the experimental class and control class. Homogeneity test was carried out to see the variation in the data in the two class groups. The balance test was carried out to see whether the two groups had equal initial competencies. As shown in Table 6, the Kolmogorov-Smirnov data normality test outcomes using SPSS 22 reveal a significance coefficient (sig) > 0.05 and a normal distribution.

Tabel 5. Descriptive Statistics of Critical and Creative Thinking Posttest

	Classes	Mean	Std. Deviation	N
Critical_Thinking	Experiment	79.00	6.633	35
	Control	70.21	6.936	34
	Total	74.67	8.060	69
Creative_Thinking	Experiment	80.94	5.076	35
	Control	71.06	7.707	34
	Total	76.07	8.154	69

Tabel 6. Normality Test Result

	Clases	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Pretest	Experiment	.137	35	.094	.966	35	.349
	Control	.144	34	071	.957	34	.203
Postest	Experiment	.088	35	.200*	.977	35	.659
	Control	.125	34	.196	.942	34	.069

Decision:
Sig value> 0.05, then it can be concluded that the data is normally distributed.

Tabel 7. Homogeneity Test Result

Variables	Significance	Descision
Critical Thinking	0.85	Homogeneous
Creative Thinking	0.77	Homogeneous

Table 7 shows the results of the homogeneity test for the two variables. If the significance value of both variables is > 0.05 then the two groups are said to be homogeneous. Next, the pretest results were carried out with a t test to see the balance between the two groups. The experimental and control groups are said to be balanced if the coefficient on the significance value in the t test shows >0.05. The results of the t test analysis can be seen in Table 8.The prerequisite test showed that the data on critical and creative thinking skills in both groups were normally distributed. The experimental and control classes are homogeneous and balanced. Then the MANOVA test is presented in Table 5 and the test of the effect between subjects in Table 9. The Wilks' Lamb-

Table 8 Balance Test Results

Class	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Exeriment	-1.046	67	.299	-.08127	.07769
Control	-1.048	66.266	.298	-.08127	.07754

da multivariate test shows the value of F = 23.93 with a significance value of 0.001 <0.005, so Ho is rejected. Thus there are differences in critical and creative thinking of students who are treated with EBESSIL and PBL learning model. The significance value of critical thinking and creative thinking shows less than 0.05, thus it can be concluded that there is a significant difference in

Tabel 9. Multivariate Tests

Learning Model Effect	Value	F	Hypothesis df	Error df	Sig.
Pillai's Trace	.420	23.932[b]	2.000	66.000	.000
Wilks' Lambda	.580	23.932[b]	2.000	66.000	.000
Hotelling's Trace	.725	23.932[b]	2.000	66.000	.000
Roy's Largest Root	.725	23.932[b]	2.000	66.000	.000

Tabel 10. Tes of between subjects effects

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	Critical Thinking	1333.775[a]	1	1333.775	28.980	.000
	Creative Thinking	1566.691[b]	1	1566.691	40.620	.000
Intercept	Critical Thinking	383945.659	1	383945.659	8342.425	.000
	Creative Thinking	400321.705	1	400321.705	10379.372	.000
Group	Critical Thinking	1333.775	1	1333.775	28.980	.000
	Creative_Thinking	1566.691	1	1566.691	40.620	.000

influence between the EBESSIl and PBL models. To determine the effectiveness of learning using learning models in experimental and control classes in empowering students' critical and creative thinking skills, the N-Gain Score calculation can be seen in tables 11. Table 11 are tables of N-gain calculation results for classes that use the EBESSIL (experimental) and PBL (control) models in the aspects of critical and creative thinking skills The critical thinking aspect in the EBESSIL class

Tabel 11. Description of Data on Assessment Results of Critical Thinking Class Students

Class	Pretest Postest	Subjek		Mean		N-Gain Score		N-Gain Score (%)	
		Creative	Critical	Creative	Critical	Creative	Critical	Creative	Critical
Experimen	Pretes	35	35	14,69	14,91	0,62	0,62	62,34	61,93
	Postes	35	35	24.29	24.29				
Control	Pretes	34	34	14.55	14.59	0.43	042	43.43	41.88
	Postes	34	34	21.29	21.06				

is categorized as moderate, namely 0.3≤ 0.62 ≥ 0.7 with a percentage of 61.93%, and the PBL class 0.3≤ 0.42 ≥ 0.7 with a percentage of 41.88% in the moderate category. The creative thinking aspect in the EBESSIL class is categorized as moderate, namely 0.3≤ 0.62 ≥ 0.7 with a percentage of 62.34% and the PBL class 0.3≤ 0.43 ≥ 0.7 with a percentage of 43.43% in the moderate category. Knowing the magnitude of the effect given by the treatment on critical and creative thinking skills, the size effect analysis can be seen in tables 12 and 13. The amount of influence after being given treatment shows a high category in the aspects of critical and creative thinking skills. In the critical thinking thinking aspect with a coefficient of 1.04, and in the Creative thinking skills aspect 1.40 with a high category. The large effect size means that the research findings have practical significance.

Tabel 12. Koofesien Effect size

Aspects	Koefesien	Criteria
Critical Thinking	1.04	Tinggi
Creative Thinking	1.40	Tinggi

Tabel 13. Result of Effect Size Test

Class	Mean	Std. Deviation	Cohen's Effect Size
Exsperiment	8.00	0.44	1.66
Control	7.06	0.66	

From the results of the effect size test of the experimental class and control class, the cohen's effect value is 1.66. From the above results, it can be concluded that the effect size value obtained shows that the treatment carried out by researchers has an influence on students' critical and creative thinking skills in the "high" category. Teachers, and student responses carry out model practicality assessments.The teacher's responses

to the EBESSIL model are an average of 89.10% in the very good category, and student responses are an average of 95.98% in the very good category. The EBESSIL model receives a positive level of practicality and can be used to implement learning objectives because students and teachers respond extremely well to it.

This study found that the effectiveness of the EBESSIL model in the experimental class can improve students' critical and creative thinking skills. The EBESSIL model has the advantage of incorporating ESSI-based learning that can stimulate students' thinking activities. The use of the environment as context, material, and learning resources results in meaningful learning. Meaningful learning is learning that can be applied to learners to develop their abilities (Onowugbeda et al., 2024). It involves making connections between new information and existing knowledge, making the learning process more interesting and memorable. When learners understand the relevance and significance of what they are learning, they are motivated and retain information better. This approach can foster deeper understanding, thinking, and problem-solving skills, ultimately improving their overall experience.

The EBESSIL model emphasises ESSI learning on aspects of everyday life in an effort to make learning meaningful. Meaningful learning is carried out through environmental problems that become social issues in society (Espino-Díaz et al., 2020) . Environmental problems that exist in society about ESSI can foster students' curiosity. The integration of ESSI in learning inside and outside the classroom can motivate learners in learning decision-making and problem solving. The problem solving described in the learning activities is related to environmental problems, namely coffee waste pollution.

This research emphasizes environmental studies, namely waste and recycling in coffee waste material. Environmental studies are used as materials, contexts and learning resources, so that the demands of meaningful learning, fun and contextual learning can be met. Students are asked to do problem solving from the concept of koi skin waste by strengthening the learning process through practicum activities. Experimental activities and contextualized learning experiences will build and develop scientific thinking habits. Scientific thinking as a form of maintaining an open mind, resulting in critical thinking skills, fostering creative ideas, recognizing various forms of basic to complex investigations, and seeking data-based knowledge. teachers utilize the ESSI concept on waste and recycling materials by directing learners to engage knowledge by developing the environment outside and inside the classroom as an effective learning area.

The effectiveness of the EBESSIL model in improving students' critical and creative thinking skills occurs because the syntax of activities in the EBESSIL learning model is designed to stimulate each aspect of students' critical and creative thinking skills. The orientation syntax allows learners to identify and interpret through reviewing existing experiences and events they encounter so that learners can transform their knowledge with the stimulus provided. The transformation of knowledge and the stimulus provided can improve the quality of the learning process (De Felice et al., 2023). Stimulus obtained through information provided by educators will stimulate learners to detect problems and recognise and understand problems from a question to stimulate thinking skills and strengthen the problem-sensitive aspects of learners. To improve knowledge transformation through stimulus and response can be done with experiential learning (Salinas-Navarro et al., 2024). Experiential learning allows learners to perform activities relevant to the ESSI material at hand. This has an impact on improving learners' understanding and application of knowledge. The stimulus provided will make learners apply existing understanding concepts in real situations. Understanding concepts in real life situations will make meaningful learning happen (Zeivots et al., 2024). Thus, using diverse and relevant stimuli in ESSI learning can improve the quality of the learning process, so that learners can understand and apply their knowledge better.

The Reflective Observation syntax strengthens learners' fluency and analysis as well as flexibility and evaluation skills. The fluency aspect is formed through ESSI observation activities carried out by learners, thus stimulating them to generate many ideas, answers, or problem-solving suggestions. From the findings of existing problems, learners can offer various answers or ways to solve problems, showing the ability to think broadly and diversely. Not only the fluency aspect is formed, the analysis ability aspect is stimulated in digesting the existing problems. This activity involves collecting, separating, and understanding the components of a fact that they find when making observations in the field. In the process of this activity, students must be able to evaluate by identifying, separating, and distinguishing the components of ESSI material. By making direct observations and collecting ESSI data, learners can see and respond from a scientific perspective

to produce problem solving and evaluate to assess the credibility of statements, findings, and other representations. In this phase, learners in groups make direct observations, collect qualitative and quantitative data, and reflect on their experiences.

The scientific background syntax strengthens learners in analysing information related to ESSI by examining new information or opinions received. Learners assess existing information and the credibility of statements or other representations so as to form the expected evaluation aspects. scientific background facilitates learners to respond to and explain problems. Learners are allowed to respond to stimulants given about ESSI coffee waste material to bring up ideas or productive thoughts about the problem so that the fluency aspect is built through learning activities in the syntax. This activity not only stimulates learners in interpreting existing experiences but also strengthens aspects of problem sensitivity so that learners can respond to existing experiences and detect problems.

The Active Experimental syntax makes it easy for learners to do problem solving. This activity begins by giving group assignments to learners to conduct ESSI problem-solving experiments on coffee waste material. Subsequently, learners in each group plan and conduct practical experiments to solve problems by making Liquid Micro Organisms (MOL) from coffee waste. This syntax will encourage learners to think flexibly and evaluate by generating solutions or approaches in solving problems, stimulating learners to assess the truth of data by assessing the credibility of findings and information obtained. Active experimental will not only empower learners in flexibility and evaluation, but this phase will stimulate learners' elaboration skills by detailing the problem and solving the problem at hand. Experimental activities can stimulate learners to make conclusions from various findings in the field and literature review (Chang et al., 2023). This activity is carried out by prioritising cooperation in groups to build learners' social skills through learning together. Not only that, this activity can improve communication and cooperation skills. It helps students understand different opinions and attitudes, as well as improve critical and independent thinking skills.

Communication syntax strengthens students in the process of understanding problems and gathering information about problems faced when carrying out practical activities. Educators organize each group of students to communicate the results of the ESSI experimental activities and explain the solutions taken in solving the problems. Communication syntax is the final stage of learning activities. This activity stimulates elaboration, inference, explanation, and self-regulation skills. Elaboration skills are targeted to improve students' abilities through sharing information, ideas, and other findings, both experimental activities that have been carried out and literature studies obtained from each group. The explanation aspect is stimulated in group discussion activities by explaining the results of the activities and findings obtained. Communication syntax targets self-regulation skills where social-emotional such as interacting with friends, showing empathy, and sharing. This happens when students have a class discussion about the ESSI experiment on the topic of coffee waste that has been carried out, so that the process of inference, question and answer, confirmation, and validation of learning outcomes occurs. An overview of the implementation of learning in Table 13. Documentation of activities can be seen in pictures 2 and 3 taken by the researcher when the biology subject teacher applied the EBESSIL learning model syntax in class.

Tabel 14. Teacher and student learning steps using the EBESSIL model

Learning Steps	Teacher activity	Student activity
Orientation	Provide initial stimulus to learners by presenting information from various ESSI problem topics.	Students pay attention to the teacher's explanation of the material presented, give responses, review the theory and supporting information related to ESSI.
Reflective Observation	Divide groups of students to carry out ESSI observation activities in the school or residential environment, and reflect on their experiences.	Learners in small groups carry out observation activities. Learners collect qualitative and quantitative data.Learners reflect on their experience.
Scientific Background	Provide opportunities for students to identify as much as possible about ESSI, present observation data, explain, and determine the context of ESSI research to be carried out.	Learners present data from observations, conduct theoretical studies, explain the context of ESSI problems that are important to solve. that they have encountered from a scientific point of view.

Learning Steps	Teacher activity	Student activity
Active Exsperimental	Give group assignments and conduct ESSI problem solving experiments.	Learners in each group plan and conduct an experiment to solve the ESSI problem.
Communicating	Educators organize each group of learners to present the findings and solutions taken in solving the ESSI problem.	Learners present the results of the experiment. Learners conduct group discussion

Figure 2. ESSI topic discussion
Source: Researcher

Figure. 3. Experimental activities
Source: Researcher

Learning activities emphasize environmental problems that become social issues of society, contextual, and group discussions to problem solving. Discussion is an important factor for students to work together in problem solving. According to (Alam & Mohanty, 2023; Hikmawati et al., 2021) group discussion is an important activity for cooperation and improving academic skills. Group discussions can develop students' ability to exchange knowledge and work together in problem solving. Problem solving increases student independence so that students can explore knowledge well (Suradika et al., 2023). Discussion forums open up space for argumentation for students and are an alternative to improving students' learning skills(Hsu et al., 2022; Nahar et al., 2022). (Saracaloglu et al., 2011) in their research found that a person's argumentation ability is in line with better thinking ability. This happens because learning activities generate debates, controversial viewpoints, and end with problem solving. Exploring knowledge is done by constructing existing knowledge with new knowledge through problem topics they find in the field. According to (Aufa et al., 2021) by involving problem solving, students can be trained to construct knowledge to a good understanding of concepts. In line with research (Leasa et al., 2023; Rafiq et al., 2023). Problems will increase student independence to a higher level so that students can explore knowledge well. The recommendation from this study is to conduct further research on the effect of the EBESSIL model in empowering students' thinking skills such as critical and creative thinking so that this model can be tested for its superiority.

CONCLUSION

The results of this study concluded that the experimental class using the EBESSIL learning model was more effective in improving students' critical and creative thinking skills compared to the control class. The EBESSIL Learning Model was effective in improving critical and creative thinking skills with each critical thinking skills effect size coefficient of 1.04 with a high category, and creative thinking skills with an effect size coefficient of 1.40 with a high category. The EBESSIL model received a very positive response from educators and students. The assessment of the practicality of the model by educators was 89.10% with a very good category, and students were 95.98% with a very good category, thus the EBESSIL learning model was declared practical and effective. The EBESSIL learning model is recommended to be applied by educators in secondary schools in improving students' low critical and creative thinking skills.

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