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The Effect of the Ethno-STEM Based Learning Model on Students Understanding of Food Additive Concepts and Their Consumptive Attitudes

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Abstract

This study aims to examine the effect of the Ethno-STEM based learning model on students understanding of food additive concepts and their consumptive attitudes. The increasing tendency of students to consume snack foods containing harmful additives highlights the need for contextual and meaningful learning approaches. Ethno-STEM integrates local cultural knowledge with scientific concepts to enhance students' learning experiences.

This study employs a mixed-method approach using questionnaires, observations, and interviews. The results are expected to indicate that the Ethno-STEM learning model improves students' conceptual understanding and promotes more critical and responsible consumption behavior. This approach also enhances students' awareness of the health risks associated with excessive consumption of synthetic additives.

Keywords: Ethno-STEM, food additives, conceptual understanding, consumptive attitude

INTRODUCTION

Education has an important role in shaping students understanding and attitudes toward

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health and consumption issues. Learning in Ethno-STEM (Ethnography, Science, Technology, Engineering, and Mathematics) is pursued model is considered an effective approach to integrate local culture, science, and technology in learning (Sutarto et al., 2021). Chemistry education can be enhanced by Ethno-STEM via the investigation of indigenous knowledge, demonstrated in the creation of customary foods utilizing natural substances like pandan leaves as dyes, palm sugar as sweetening agents, and rock salt as preservatives.

With a deeper understanding and a culturally relevant approach, it is expected that there will be positive changes in students' consumptive attitudes toward snack foods. Therefore, this research is conducted as an effort to teach ethnoscience and to build students' critical awareness of the products they consume.

Significant transformations in multiple life domains, such as education and consumption habits, have been introduced by the ongoing progression of science and technology. One of the issues of concern is the high level of students' consumptive attitudes toward snack foods containing food additives. Food additives such as colorants, preservatives, and artificial sweeteners are often used to increase the attractiveness and durability of food products. However, excessive use of these additives can have negative impacts on health, especially for students who are still in the growth stage.

The rapid development of the snack food industry, especially among school children, has increased the availability of products containing harmful additives such as synthetic colorants, preservatives, and artificial sweeteners that exceed safe consumption limits (BPOM, 2022). Students, as active consumers, often lack understanding of the health impacts of these substances, which leads to consumptive behavior without considering nutritional value and safety.

According to Notoatmodjo (2007), knowledge plays an important role in shaping attitudes. Students with better knowledge about food tend to have better attitudes in selecting food. Therefore, an appropriate learning approach is needed to improve students' understanding and reduce consumptive behavior.

The effect of the Ethno-STEM-based learning model on students' comprehension of food additive concepts and their consumption attitudes is aimed to be analyzed in this study based on these considerations.

Based on the research objectives, the conceptual framework of this study is illustrated in Figure 1.

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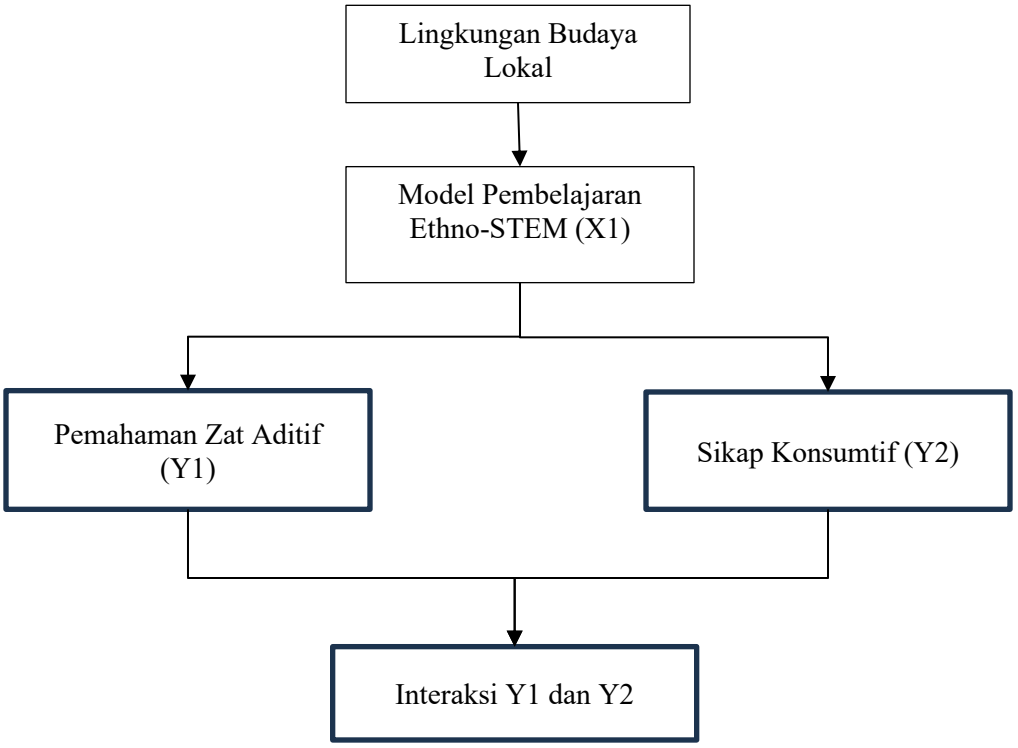


Figure 1. Conceptual Framework of the Study

ETHNO-STEM LEARNING MODEL

The Ethno-STEM learning model combines the STEM approach with local wisdom (ethnopedagogy), which is expected to improve students understanding of food additives while also influencing their consumptive attitudes. According to Rosa and Orey (2021), its implementation includes activities such as analyzing the content of additives in traditional foods compared to packaged foods, conducting simple experiments to detect substances such as borax or synthetic dyes, and developing projects to create healthy food using local scientific concepts are not only conveyed by this method but students' critical understanding of the products they use is also developed.

Chemistry learning is often considered abstract and not sufficiently contextualized with students' daily lives. Learning models that do not integrate local culture and real-life practices tend to result in low student engagement and critical thinking. Therefore, a contextual learning approach such as Ethno-STEM is needed to provide meaningful learning experiences that are relevant to

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students' lives (Sutarto et al., 2021).

A learning strategy called Ethno-STEM combines ethnographic studies (cultural exploration) with STEM (Science, Technology, Engineering, and Mathematics). The goal of this framework is to link scientific education with indigenous cultural settings, which helps learners grasp the importance of science in daily experiences. Students' conceptual grasp of science is intended to be improved by Ethno-STEM through local traditions, while 21st-century skills including creativity, analytical thinking, and teamwork are cultivated, and local knowledge is conserved via science and technology (Sutarto et al., 2022). @Kristallgreen1

The components of the Ethno-STEM learning model can be described as follows:

Table 1. Components of the Ethno-STEM Learning Model

component	Explanation	Examples in the Context of Additives
Science	Studying scientific concepts of natural/cultural phenomena.	Chemical analysis of natural additives (turmeric, pandan leaves) vs. synthetic.
Technology	Use of modern tools for scientific exploration.	Food barcode scanner app, simple borax test using turmeric.
Engineering	Designing problem-based solutions.	Making healthy food packaging from natural ingredients.
Mathematics	Measurement, calculation, and data analysis.	Calculate the safe dose of additives per day.
Etnosains	Linking science with local culture.	Study of traditional food preservation (examples: salted fish, dodol).

Several learning theories provide the theoretical basis for Ethno-STEM. Initially, the constructivism theory, developed by Piaget and Vygotsky, suggests that knowledge is created by students via firsthand experience and social engagement. Within Ethno-STEM, scientific knowledge is developed by learners through their interaction with their cultural surroundings. Additionally, multicultural education, as described by Banks in 1993, highlights the significance of valuing cultural diversity within educational settings. Lastly, the integration of STEM disciplines,

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as explained by Bybee in 2013, merges science, technology, engineering, and mathematics to address practical problems, which in Ethno-STEM relates directly to indigenous cultural customs.

FOOD ADDITIVES

To enhance the quality, flavor, appearance, and durability of food, various substances are incorporated known as food additives. Either naturally sourced or artificially created, these substances fulfill particular roles in the processing and preservation of food items. As stated by BPOM (2022), food additives are divided into categories of natural additives, which include turmeric, salt, and palm sugar, and synthetic additives, including saccharin, monosodium glutamate (MSG), and tartrazine.

Several types of food additives commonly found in snack foods include colorants, preservatives, sweeteners, flavor enhancers, and thickeners (WHO, 2020). While these additives serve important functions, excessive use can pose health risks. In addition, some hazardous substances such as Rhodamine B, formalin, and borax are sometimes misused in food products, which can lead to serious health problems (EFSA, 2022).

Understanding food additives is essential for students in order to develop awareness of potential health risks. Students are expected to be able to identify types of additives, distinguish between natural and synthetic substances, and understand their effects on health. This understanding can influence students' attitudes and encourage them to make healthier food choices (BPOM RI, 2021).

STUDENTS CONSUMPTIVE ATTITUDES

Consumptive attitude refers to the tendency of individuals to purchase goods or services based on desire rather than need. This behavior is often influenced by external factors such as advertising, social trends, and peer pressure, as well as internal factors such as knowledge and self-control. Among students, consumptive attitudes are often reflected in their behavior toward snack foods that contain food additives.

Common characteristics of consumptive behavior include purchasing based on advertising, impulsive buying, peer influence, and lack of consideration of long-term health impacts. These behaviors can lead to negative consequences, including health problems, financial issues, psychological effects, and environmental concerns.

Previous studies indicate that students with better understanding of food additives tend to be more selective in choosing food. Therefore, improving students' conceptual understanding

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through approaches such as Ethno-STEM can help reduce consumptive attitudes and promote healthier consumption behavior.

METHOD

A quasi-experimental approach utilizing a pretest–posttest control group format was employed in this research (Bougie & Sekaran, 2019). Two groups were included in the study: the Ethno-STEM-based learning model was applied to the experimental class, while the control class was instructed using the STEM learning model.

The research design used in this study is presented in Table 2.

Table 2. Quasi-Experimental Research Design

Kelas	*Pree Test*	Perlakuan	*Post Test*
Kelas Esperimen	0I	X	02
Kelas Kontrol	03	-	04

At SMK Negeri 1 Limboto, the group was composed of 40 grade XI APHP students, separated into two groups: one experimental class with 20 students and one control class also containing 20 students.

A cognitive assessment was utilized to gather data on students' grasp of food additive ideas, accompanied by a Likert-scale survey designed to evaluate students' consumption-related attitudes. Multiple-choice and essay formats composed the test, whereas the survey employed a rating spectrum from strongly disagree to strongly agree.Data analysis was conducted using independent samples t-test or Mann–Whitney U test for conceptual understanding, and ANCOVA or Wilcoxon test for consumptive attitudes, depending on data distribution. Moderated Regression Analysis (MRA) was used to examine the interaction between variables.

DISCUSSION

A cognitive assessment was utilized to gather data on students' grasp of food additive ideas, accompanied by a Likert-scale survey designed to evaluate students' consumption-related attitudes. Multiple-choice and essay formats composed the test, whereas the survey employed a rating spectrum from strongly disagree to strongly agree.This improvement can be interpreted as

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the result of contextualized learning. By integrating local wisdom into scientific content, Ethno-STEM enables students to connect abstract concepts with familiar real-life practices. Such connections likely support deeper cognitive processing, allowing students to construct more meaningful and retained understanding.

Additionally, the reduction in score variability in the experimental group indicates a more consistent learning outcome across students. This suggests that the Ethno-STEM model not only enhances overall performance but also supports a more equitable distribution of understanding, particularly by helping students with lower initial abilities improve alongside their peers.

The descriptive statistics of students' consumptive attitudes in both the experimental and control groups are presented in Table 3 and Figure 2.

Table 3. Descriptive Statistics of Students' Consumptive Attitude

Group	Test	N	Mean	SD	Max	Min
Experimental	Pre-test	20	72.25	5.24	85	62
Experimental	Post-test	20	72.40	4.55	81	64
Control	Pre-test	20	74.10	6.12	88	67
Control	Post-test	20	67.00	2.08	69	62

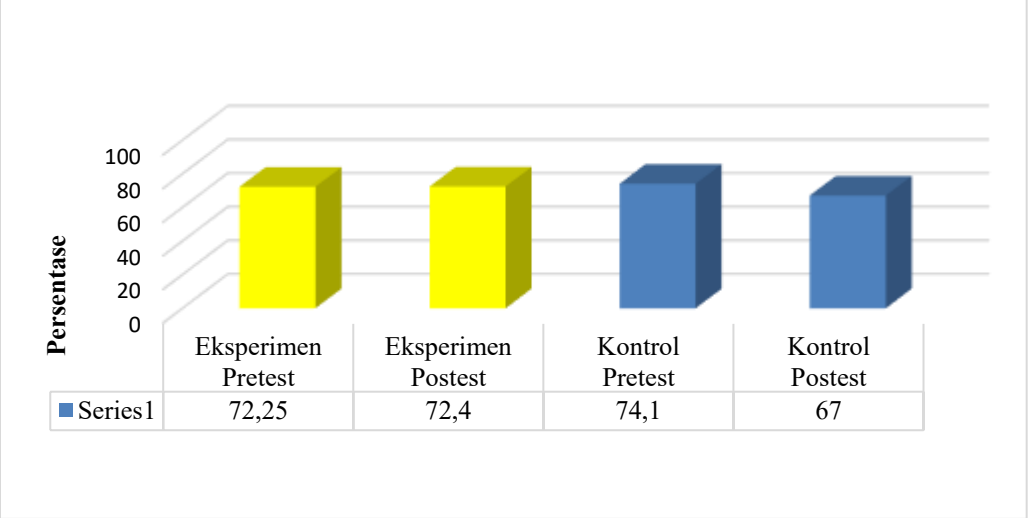


Figure 2. Comparison of Pre-test and Post-test Mean Scores

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Based on Table 3 and Figure 2, the experimental group demonstrates a stable trend, while the control group shows a noticeable decline in consumptive attitudes.

In contrast, the effect on consumptive attitudes shows a different trend. While both groups initially demonstrated positive attitudes, only the experimental group was able to maintain this condition after the intervention. The stability of scores in this group suggests that Ethno-STEM plays a role in reinforcing existing positive attitudes rather than significantly increasing them.

Meanwhile, the decline observed in the control group indicates that attitudes may not be sustained effectively in the absence of meaningful and context-based learning experiences. This finding highlights that affective outcomes, such as attitudes, require not only information delivery but also contextual reinforcement to remain stable.

Taken together, these results indicate that Ethno-STEM offers a more holistic learning approach. Its strength lies not only in improving cognitive outcomes but also in maintaining affective aspects of learning. The integration of cultural context appears to be a key factor in making learning more relevant, thereby supporting both understanding and attitude formation.

CONCLUSION

A cognitive assessment was utilized to gather data on students' grasp of food additive ideas, accompanied by a Likert-scale survey designed to evaluate students' consumption-related attitudes. Multiple-choice and essay formats composed the test, whereas the survey employed a rating spectrum from strongly disagree to strongly agree.

FUTURE DIRECTIONS

Further research is recommended to involve additional variables, such as learning outcomes, motivation, prior knowledge, and learning styles, in order to provide a more comprehensive understanding of the effectiveness of the Ethno-STEM learning model.

In addition, future studies may consider broader research settings and conditions to strengthen the generalizability of the findings.

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