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RESEARCH ARTICLE

THE ROLE OF COOPERATIVE INSTRUCTIONAL STRATEGIES ON INTEGRATED SCIENCE PROCESS SKILLS

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Abstract

Research has shown that integrated science process skills are crucial in the modern-day world. In this study, we used secondary school students enrolled in the science classes to determine the role of cooperative instructional strategy on the student's integrated science process skill. Ninety-eight students participated in the study. We adopted a pre-test post-test research design in the study. The participants were grouped into two different groups for the pre-test and post-test studies. The experimental group was exposed to the cooperative instructional teaching method, while the control group was taught conventionally. Test of Integrated Science Process Skills (TISPS) was used to assess the participant's integrated science process skills. An independent-samples t-test was run to determine if there were differences between the experimental and the control groups on integrated science process skills in the post-test study. The integrated science process skills increased in the experimental group (4.71 ± 4.91) than the control group (23.01 ± 4.27), a statistically significant difference of 18.68 (95% CI, 16.83 to 20.54), $t(96) = 20.026$, $p = .001$ was established. It was concluded that cooperative instructional strategy enhances student's performance integrated science process skills. The study recommends that teachers should be regularly trained on the use of cooperative instructional strategies.

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Introduction:-

Science is one of the essential subjects in shaping the intellectual, competitive, and skilled generation of the future (Mat, 2019). Skills in science inquiry enable individuals to design and conduct scientific research to solve human and societal problems. Integrated science process skills are crucial for dealing with issues identified or doing science experiments (Ongowo, 2017). Integrated science process skills denote the ability to operationally define concepts, formulate related hypotheses, interpreted related data, experimentation, and present outcome (Karim et al., 2017). Perhaps, integrated science process skills indicate that a student can probably identify, interpret, and predict variables using systematic procedures and convey a novel outcome (Sulistri, 2019). It allows students to learn what it means to do science, solve problems and develop thinking skills (Cruz, 2015). Science process skills are the fundamentals of critical thinking and scientific inquiry (Chokchai&Pimde, 2019; Derilo, 2019; Shahali& Halim, 2010), and it is vital in assessing the knowledge about the process of science as reflected by students' skill performance (Aydinli et al., 2011). (Fah et al., 2019) reported a possible link between integrated science process skills, logical thinking abilities, and science achievement. These skills are critical in our modern-day world,

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irrespective of location (Tek et al., 2013), due to the rising technological advancement. Therefore, beginners must acquire integrated science inquiry skills, regardless of their nationality or socioeconomic status.

Science process skills denotes a set of broadly transferable abilities suitable to many science disciplines and reflective of scientific behavior (Ismail & Jusoh, 2001). Science process skills comprise basic and integrated science investigation skills. The basic science process is concerned with basic skills in scientific investigation, which makes them higher-order reasoning skills. Previous research (Harlen, 2014; Osman, 2012) advocates for developing science inquiry skills in learners. The underlying emphasis of science process skills is to create scientific skills relating to formulating hypotheses, identifying, controlling, and manipulating variables, operationally defining variables, designing and conducting experiments, collecting and interpreting data, and solving problems. Nevertheless, there is a growing concern about the decline in science education performance among students across the school setting. Poor performance in scientific skills related to inquiry skills suggests that students lack higher-order thinking skills, which contributes to their overall poor performance in science subjects, which has been the norm among students.

The cooperative instructional approach refers to a teaching tactic that demands dividing learners into groups with students of diverse levels of ability using various instructional activities to improve their understanding of the concept. Perhaps, group members are expected to work together to produce a joint and desired outcome. Cooperative methods are a powerful tool for cultivating healthy classroom participation and writing competence (Prata et al., 2019). Hence, teachers should be trained to utilize the cooperative learning approach in the classroom (Ifamuyiwa & Akinsola, 2008). Research suggests adopting a cooperative instructional strategy to enhance students learning (Adebayo & Judith, 2014; Akinsola & Ifamuyiwa, 2008; Appiah-Twumasi et al., 2020; Nnorom, 2015; Sa'adu Matazu & Julius, 2018; Yunusa et al., 2014).

The current upsurge in technological developments calls for a total transformation in the educational curriculum, especially STEM education. Science teaching should focus on practical investigations, experiments, and science inquiries to develop integrated science process skills. Over the years, scholars around the world have attempted to develop strategies targeted at enhancing student's integrated science process skills (Andromeda et al., 2019; Bhakti et al., 2020; Candrawati et al., 2020; Istikomah et al., 2020; Juhji & Nuangchalerm, 2020; Leonor, 2015; Rahardini et al., 2017; Rukmana, 2018; Syukri et al., 2018; Wesley et al., 1985; Wulandari et al., 2019). For example, (Elfeky et al., 2020) found that using advance organizers in the flipped classroom increased the integrated science process. Lati et al. (2012) reported that science inquiry activities effectively enhanced student's integrated science process skills. The findings (Rahmani et al., 2013) showed that peer scaffolding significantly increased integrated science process skills. (Romadhona & Suyanto, 2020) used open inquiry learning model and found it helpful in integrated science process skills. This study employed cooperative instructional methods to enhance secondary school students' integrated science process skills. Our main objective is to investigate the role of cooperative instructional strategies on integrated science process skills among secondary school students.

Method:-

To achieve the aim of the current study, we recruited ninety-eight students from public and private secondary schools in the Kogi State of Nigeria as participants. The students were all in the science classes and included males and females between the ages of 13 and 18 years. We first sought authorization from the relevant heads of the schools. After that, with the aid of the teachers, the students were prepared for the study. However, they were made to understand that participation in the study was entirely voluntary and that no harm is associated with the investigation. Those who consented were allowed to participate in the study. We adopted a quasi-experimental design with a pre-test, post-test control group. The participants were assigned to groups. Group (A) experimental and group (B) the control group. Firstly, we subjected the students to a pre-test study to establish their performance in integrated science process skills using the Test of Integrated Science Process Skills (TISPS) developed and validated by Kazeni (2005). After that, we commenced the post-test study. We exposed Group A (i.e., experimental group) to the cooperative instructional teaching method. On the other hand, the control group was taught conventionally. In the end, the instrument was readministered to determine if any difference exists between the two groups in relation to integrated science process skills.

Result:-

Table 1:- Table shows mean and standard deviation scores of the students' performance in integrated science process skills for groups A and B.

Group	N	M	SD
Group A	50	23.01	4.18
Group B	48	23.78	5.54

The table shows that $M = 23.01$, $SD = 4.18$, and $M = 23.78$, $SD = 5.54$ were recorded for the two conditions in the pre-test study. Thus, the table indicates no significant difference in the mean scores of the experimental and the control groups, which means that the groups were in the same category of performance in integrated science process skills.

Table 2:- Table showing the mean and standard deviation scores of the performance outcome of the two groups (A and B) following the Post-test.

Group	N	M	SD
Group A	50	41.71	4.93
Group B	48	23.01	4.27

The above table shows that $M = 41.71$, $SD = 4.93$, and $M = 23.01$, $SD = 4.27$ was obtained for the two conditions following the post-test study. The data revealed a high mean score for the experimental group ($M = 41.71$) compared to the control group ($M = 23.01$). The standard deviation scores also indicated a higher $SD = 4.93$ for the experimental group and a decreased $SD = 4.27$ for the control group. Therefore, we assume that the mean indicates an affirmation that the experimental group's performance increased following the introduction of cooperative instructional strategy.

Table 4:- Table showing the t-test comparison of the integrated science process skills performance of the experimental and control group.

Source of variation	N	M	SD	df	t	Sig
Group A	50	41.71	4.91			
Group B	48	23.01	4.2796	20.026	000	

An independent-samples t-test was run to determine if there were differences between the experimental and the control groups on integrated science process skills in the post-test study. The integrated science process skills increased in the experimental group (41.71 ± 4.91) than control group (23.01 ± 4.27), a statistically significant difference of 18.68 (95% CI, 16.83 to 20.54), $t(96) = 20.026$, $p = .001$.

Discussion:-

Following our assumption that cooperative instructional strategy will enhance the students integrated science process skills. An independent t-test was conducted on the data, and the result established a statistically significant difference between the experimental and control group. Thus, the result affirmed our expectation that the cooperative instructional approach could enhance integrated science process skills, 18.68 (95% CI, 16.83 to 20.54), $t(96) = 20.026$, $p = .001$. The result indicates that adopting a cooperative learning approach in secondary schools may be a better option in increasing integrated science process skills. The finding is consistent with Agwudu, (2018), who found that both cooperative learning instructional strategies significantly enhanced students' achievement in organic chemistry better than the lecture method. Also, the result supports Aluko (2008), who reported that cooperative instructional strategy is more effective in enhancing the better performance of the learners. Scholars in Nigeria have applied cooperative instructional methods in various domains of learning (Esan, 2015; Inuwa et al., 2017; Leam & Studies, 2009). One common feature of the authors' reports is that the cooperative instructional method proved effective in learning compared to the conventional way. Our results provide insight into the effectiveness of the cooperative instructional approach in integrated science process skills.

Conclusion:-

The study aimed to study the role of cooperative instructional strategy on student's integrated science process skills. Thus, it was concluded that cooperative instructional strategy enhances student's performance integrated science process skills. The study contributes to science education literature by identifying cooperative instructional strategy as a teaching method that could be used to improve integrated science process skills among secondary school students in Nigeria. Nevertheless, the present study encountered certain limitation that needs to be reported. First,

the sample size was small and may not be reliable for generalization. Also, the design of the study did not allow for cause-effect determination. Future researchers are advised to include more representative samples and adopt pure experimentation to ascertain cause-effect relationships. However, we recommend that teachers be regularly trained on the use of cooperative learning methods, and research should continue exploring other learning methods capable of enhancing integrated science process skills.

Ethical consideration

The researchers made sure that the study procedures involving human participants were done following the ethical standard of the institution.

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