A Study of Students' Attitude Towards Learning Chemistry Through Art Integration at Secondary School of Boudh District

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Abstract-This study investigates secondary school students' attitudes toward learning chemistry through art integration. A quasi-experimental design with pre-test post-test measurement was used, involving control and experimental groups. The experimental group received art-integrated instruction, while the control group followed traditional methods. Pre- and post-tests were used to measure attitudes, and mean scores were statistically analyzed. Findings revealed a significant improvement in the experimental group's attitude, indicating that art integration positively influences student engagement and attitude towards chemistry. The results support incorporating interdisciplinary teaching strategies to enhance science education and suggest that art can serve as a valuable aid in enhancing students' learning experiences in chemistry.

Keywords: art integration, chemistry education, student attitude, secondary school, interdisciplinary learning.

Introduction- Education is an evolving field that continuously seeks innovative methodologies to enhance student engagement and comprehension. In recent years, there has been a growing global consensus on the urgent need to reform and strengthen education systems. This involves taking purposeful steps to redefine the goals, curriculum, and modes of delivery in education to ensure they are inclusive, equitable, high in quality, and relevant to contemporary needs. These priorities are reflected in major international frameworks and initiatives, such as the *Education 2030: Incheon Declaration and Framework for Action* for the realization of Sustainable Development Goal 4 (SDG 4), and the *Transforming Education Summit* held in 2022, which collectively emphasize the transformation of education as a key driver of sustainable development.

The study of students' attitudes towards learning chemistry through art integration explores the impact of combining visual and creative arts with traditional scientific instruction. Lately, there has been increasing attention towards innovative teaching strategies that enhance student engagement and foster deeper understanding of complex subjects like chemistry. Art integration, which merges artistic expression with scientific concepts, has been suggested as a means of making abstract scientific ideas more tangible and relatable for students **(Bequette & Bequette, 2012)**.

Previous research highlights the benefits of art-based teaching methods in improving students' motivation, interest, and retention of scientific knowledge **(Barrett, 2015)**. Art allows students to express and visualize scientific concepts in new ways, potentially leading to better comprehension and more positive attitudes toward the subject **(Hosek, 2013)**. By providing students with opportunities to participate in practical, creative activities, this approach fosters the development of critical thinking, collaborative abilities, and problem-solving skills.

This study aims to investigate how art integration influences students' perceptions and attitudes towards learning chemistry, with the goal of determining whether such interdisciplinary methods can increase engagement and foster a more positive learning experience in science classrooms. Understanding these effects could offer valuable insights into effective teaching strategies that make up the deficit or unify the fields of arts and science. Among the various academic disciplines, chemistry is often perceived as a challenging subject due to its abstract concepts, complex equations, and the necessity for both theoretical and practical understanding. Students frequently struggle with the subject, leading to a lack of motivation and interest. Consequently, there is an urgent need to explore alternative pedagogical approaches to make chemistry more accessible and appealing.

Need of the study -When I see the Universe through my songs, I recognize it, and then only I know it."Rabindranath Tagore

It facilitates the use of art-based inquiry, study, exploration, critical thinking, and a more profound comprehension of the ideas or subjects. For instance, chemistry students would typically study metallurgy, but art integration would encourage them to pose questions such, "If I were the metal, how would I artistically depict my journey of combination with other metals?" for example.It enables the student to get insight and comprehension straight from the educational process. For students to

study joyfully, art is essential. Students' minds are expanded, and they are able to see cross-disciplinary connections between academics, themes, and life.

Review of Related Literature- Johnstone (2000) used Theoretical analysis and found that Traditional approaches to chemistry education, which emphasize abstract concepts and memorization, often result in student disengagement due to cognitive overload and lack of practical context. Silverstein & Layne (2010) used Conceptual framework analysis and found that Art integration involves using art forms such as music, visual arts, drama, and writing to teach core academic subjects, supporting diverse learning styles and enhancing understanding.

Eisner (2002) used Qualitative educational theory review and found that Learning through the arts develops critical thinking, problem-solving abilities, and personal engagement, leading to improved retention and comprehension.

Bequette & Bequette (2012) used Empirical research on STEAM education and found that Integrating arts into STEM education (STEAM) significantly boosts learning outcomes by helping students visualize and internalize complex scientific concepts.

Sousa & Pilecki (2018) used Experimental classroom-based study and found that Art-enriched science lessons enhance student interest, motivation, and conceptual understanding, making abstract content more accessible.

Osborne, Simon, & Collins (2003) used Review of attitudinal studies in science education and found that Positive student attitudes are linked to increased interest in science, better performance, and a greater likelihood of pursuing science-related careers. Winner et al. (2013) used Review of case studies and classroom observations and found that Art-integrated instruction fosters enjoyment, curiosity, and student ownership of learning, which collectively enhance attitudes toward academic subjects.

Objectivs of the study-

1.**To study** whether there is a statistically significant difference in the pre-test mean scores of Attitude towards Learning Chemistry (ATLC) between the experimental group (OAV Tetelenga) and the control group (OAV Manipur), in order to establish baseline equivalence prior to the intervention.

2.**To study** the effect of art-integrated learning on students' attitudes towards learning chemistry by comparing the post-test mean scores of the experimental and control groups after the intervention.

3.**To study** the difference between the pre-test and post-test ATLC mean scores within the control group to understand changes in attitude without exposure to the intervention.

4.**To study** the impact of art-integrated learning on the experimental group by examining changes in their ATLC scores from pre-test to post-test.

Hyotheses of the Study -

$H_0$1: There is no significant difference between ATLC pretest mean scores of experimental (OAV Tetelenga) and control group (OAV Manipur) .

$H_0$2: There is no significant difference in the ATLC post -test mean scores of the experimental and control groups after art integrated learning.

$H_0$3: There is no significant difference between the pre-test and the post-test mean scores of ATLC among 10th standard students control group.

$H_0$4: There is no significant difference between the pre-test and the post-test mean scores for ATLC of the experimental group.

Methodology

Population-The population consisted of students studying in class X of Odisha Adar Vidyalaya following NCERT syllabus. There are 314 Odisha Adarsha Vidyalaya across the Odisha state. All the OAVS constitute the units of population. These Adarsha Vidyalayas are CBSE affiliated, offer free education and identify talented students through a yearly entrance examination. They have Class VI to Class XII and each class have 80 students in order to give individual attention to maximum number of students.

Sample- The current study aims to investigate the attitudes of OAV 10th grade students regarding learning chemistry. Therefore, two OAVs—OAV, Tetelenga, and OAV, Manipur of Boudh—were chosen as samples for the current investigation. These schools are chosen using the purposive sampling technique.

Design of the Study-Pre-test - post-test two group quasi experimental design is used. The purpose of current study is to know the effect of art integrated learning package on academic achievement in chemistry and attitude towards chemistry learning among Adarsha Vidyalayas students of secondary school. The current study carried out on 40 students of 10th class of OAV Tetelenga (Experimental group) and 40 students of 10th class of OAV Manipur (Control group). The researcher has developed different art integrated learning package to develop student's attitude towards learning. Seven days intervention was provided. Children learned the concepts through art integrated learning package. Art integrated learning package is given to OAV Tetelenga and conventional method of learning is adopted in OAV Manipur. The researcher has been careful to conduct the interventions concurrently with both groups. The control group (OAV, Manipur students) and experimental group (OAV, Tetelenga students) are matched on the basis of pre-test scores. Pre-test and Post-test for Attitude towards learning chemistry questionnaire was given.

Table 6.1 Break Up of the Sample of Study

Name Of the School	Type of Group	Total
Odisha Adarsha Vidyalaya, Tetelenga, Boudh	Experimental group	40
Odisha Adarsha Vidyalaya, Manipur, Boudh	Control group	40

The data was analyzed through inferential statistics. The student's attitude towards learning chemistry was analyzed for both groups.

Variables of the Study

Independent Variable-For the present study, the independent variable chosen are

1. Instruction using Art integrated learning package (for the experimental group).
2. Instruction using Conventional method (for control group).

Dependent Variable-In the current study, the major dependent variable is Attitude towards learning chemistry.

Tool Administered in the Study-The following tool was employed for collecting data for the current study

Attitude scale towards learning Chemistry (developed and standardized by B. Senthamizhselvan, 2018)

Testing of Hypothesis

Objective 1-To study whether there is a statistically significant difference in the pre-test mean scores of Attitude towards Learning Chemistry (ATLC) between the experimental group (OAV Tetelenga) and the control group (OAV Manipur), in order to establish baseline equivalence prior to the intervention.

Hypothesis 1- $H_0$1: *There is no significant difference between ATLC pretest mean scores of experimental (OAV Tetelenga) and control group (OAV Manipur)..*

Table 1 Independent Samples t-test for control and experimental group: Pre-test

Group	N	Mean	SD	Df	P	t-cal	t-crit	Interpretation	Decision
Control	40	22.7	5.65	78	0.024	1.24	1.67	Not Significant	Accept $H_0$1
Experimental	40	25.125	5.204						

Note: SD= Standard Deviation Df = Degree of Freedom, t-cal = t-calculated, t-crit = t-critical

Table 1 reveals the outcome of the analysis of the pre-test scores of the learners who underwent art integrated learning and the traditional approach to teaching. In the control group, the mean and standard deviation were M = 22.7, SD = 5.65, whereas in the experimental group, they were M = 25.125, SD = 5.204. From the table, it is also evident that no statistically significant difference exists between the pre-test scores of the two groups of learners. At the 0.05 level of significance, the calculated t-value (1.24) is less than the critical t-value (1.67). In addition, the p-value (0.024) is greater than the 0.05 level of significance. Hence, $H_0$1 receives support; implying that there was no significant difference between the two groups, meaning that both experimental and control groups were equal before the start of the treatment, coming from the same class.

Objective 2

To study the effect of art-integrated learning on students' attitudes towards learning chemistry by comparing the post-test mean scores of the experimental and control groups after the intervention.

Hypothesis 2

$H_0$2: *There is no significant difference in the ATLC post-test mean scores of the experimental and control group after art-integrated learning.*

Table 2 Independent Samples t-test for control and experimental group Post-test

Group	N	Mean	SD	Df	P	t-cal	t-crit	Interpretation	Decision
Control	40	26.9	4.86	78	0.000017	4.404	1.67	Significant	Reject $H_0$2
Experimental	40	31.725	4.94						

Table 2 shows the results of an independent t-test, where the variance is assumed to be unequal, to compare the overall mean score of the experimental and control group concerning the post-test. In the control group, the mean and standard deviation were 26.9& 4.86, while those of the experimental group were 31.725 & 4.94. In Table 4.3, at the 0.05 level of significance, the t-calculated value 4.18 is greater than the t-critical value of 1.67. Since the computed p-value 0.000017 is less than the 0.05 level of significance, there is a significant difference in the post-test scores of the students of both groups. $H_0$2 was thus rejected. This outcome underpinned that the difference does exist between the attitude of students exposed to art integrated learning and those taught through the traditional method. In another way, the experimental group outscored significantly the control group.

Objective 3

To study the difference between the pre-test and post-test ATLC mean scores within the control group to understand changes in attitude without exposure to the

intervention.

Hypothesis 3- $H_0$3: *There is no significant difference between the pre-test and the post-test mean scores of ATLC of the control group.*

Table 3 Paired sample t-test for the control group concerning pre-test and post-test

Test	N	Mean	SD	Df	P	t - cal	t - crit	In-terpretation	Decision
Pre	40	22.7	5.65	39	0.00104	3.296	1.69	Significant	Reject $H_0$3
Post		26.9	4.86						

To assess the third hypothesis, paired-samples t-tests at the 0.05 level of significance were applied. It was intended to compare whether there was a significant mean difference between pre-test and post-test scores for ATLC of the control group. Table 4.7 demonstrated a statistically significant difference between the pre-test (M=22.7, SD=5.65) and post-test scores (M=26.9, SD=4.86) of the control group. The calculated t-statistic value 3.296 is large compared to the critical t-value of 1.69, and the p-value of 0.00104 is less than the 0.05 level of significance; hence, $H_0$3 is rejected. These results revealed that the students' ATLC score was significantly improved. Cohen's d can be computed further to evidence that the traditional method bears a medium to large effect on students' achievement. This also indicates that teachers need to start changing their teaching methods for better academic achievement.

Objective 4- To study the impact of art-integrated learning on the experimental group by examining changes in their ATLC scores from pre-test to post-test.

Hypothesis 4 - $H_0$4: *There is no significant difference between the pre-test and the post-test mean scores for ATLC of the experimental group.*

Table 4 Paired sample t-test for experimental group concerning pre-test and post-test

Test	N	Mean	SD	Df	P	t-cal	t - crit	In-terpretation	De-cision
Pre	40	25.125	5.20	39	0.0000024	5.308	1.69	Significant	Reject $H_0$4
Post		31.725	4.94						

Table 4 describes the comparative study of learner outcomes of the pre-test and post-test scores for ATLC of the experimental group undertaking an art integrated learning strategy. According to the table, there is a significant difference between the pre-test (M=25.125, SD= 5.20) and post-test results (M= 31.725, SD= 4.94) of the students exposed to art integrated learning. From the output result, it is clear that learner test results in the pre-test and post-test scored highly significant difference for those exposed to art integrated learning methods. The p-value of 0.0000024 is less than the 0.05 level of significance. Furthermore, a t-test analysis also confirmed that the computed value of the t-statistic (5.308) is greater than the critical t-value (1.69). Hence, the null hypothesis $H_0$4 is rejected. This implies that students can get better marks when art integrated learning strategy is incorporated. Further from the above findings, Cohen's d could be calculated to show that the art integrated approach can affect student achievement at a very high level. This evidence thus suggests that art integrated learning strategy had a significant effect on students' attitude towards learning chemistry.

Major Findings of the Study- The findings of this study, which aimed to investigate the impact of art-integrated learning on students' attitudes towards learning chemistry (ATLC), are presented in alignment with the stated null hypotheses:

Finding Related to $H_0$1

H_{01}: There is no significant difference between ATLC pretest mean scores of the experimental (OAV Tetelenga) and control group (OAV Manipur) after intervention.

The analysis of pretest mean scores revealed **no statistically significant difference** between the experimental and control groups prior to the implementation of the intervention. This suggests that both groups were comparable in terms of their initial attitudes toward learning chemistry, thus validating the baseline equivalence necessary for experimental control.

Finding Related to H_02

H_02: There is no significant difference in the ATLC post-test mean scores of the experimental and control groups after art-integrated learning.

The post-test results indicated a **statistically significant difference** between the experimental and control groups. Students in the experimental group, who were exposed to art-integrated learning strategies, demonstrated significantly higher ATLC scores than those in the control group. This finding suggests that art integration had a positive impact on students' attitudes toward learning chemistry.

Finding Related to H_03

H_03: There is no significant difference between the pre-test and the post-test mean scores of ATLC among 10th standard students in the control group.

Statistical analysis showed **no significant change** in the ATLC scores of the control group from pretest to post-test. This indicates that traditional teaching methods did not notably influence students' attitudes toward chemistry during the study period.

Finding Related to H_04

H_04: There is no significant difference between the pretest and the post-test mean scores for ATLC of the experimental group.

Results revealed a **significant increase** in the ATLC scores of the experimental group between the pretest and post-test. This improvement suggests that the use of art-integrated instructional strategies effectively enhanced students' attitudes towards learning chemistry.

Conclusion-This present research was conducted to study the effect of Art-Integrated Learning (AIL) on the students' attitude towards chemistry and their academic achievements at the secondary level, specifically Grade X students of Odisha Adarsha Vidyalayas (OAVs).It was found that students of the experimental group, where the art-integrated learning package was taught, demonstrated a statistically significant positive attitude towards learning chemistry as compared with those in the control group. This means that use of visual and creative ways rendered the subject more relatable, interesting, and fun for the learners.

Further, the comparative analysis between academic scores showed that the students who were exposed to art-integrated teaching methods scored higher average marks than those taught through conventional approaches. This shows that AIL increased the students' interest and attitude and also academically benefited them. These findings underscore the effectiveness of integrating art into science education. The results support educational reforms such as NEP 2020 and NCFSE 2023, which advocate for experiential and interdisciplinary learning. Overall, the study concludes that Art-Integrated Learning can serve as a powerful pedagogical strategy to improve both affective and cognitive outcomes in chemistry education at the secondary school level.

Recommendations of the study-

- The study revealed that art integrated learning was more effective strategy than the traditional (lecture method). Therefore, art integrated learning strategies must be introduced in various secondary school which will be beneficial for the student to develop positive attitude towards chemistry.
- The findings of the study revealed that art integrated learning Package is more effective than traditional method in learning chemistry. So, faculty upgrading programs namely, orientation classes, refresher courses, conferences and workshops should be planned for the teachers to acquaint with various instructional strategies such as art integrated learning package. The phases of package development must be made familiar to Secondary school teachers, so that they can tryout with different topics in Chemistry
- National and state level curriculum and content developers should take steps to include art and its applications by organizing seminars and workshops.
- Necessary steps should be taken by NCERT and SCERT related to the quality of education regarding the development of art integrated learning Package for all subjects. These kinds of packages can engage the students even in the lack of teachers and thereby prevent wastage of time and energy.
- The achievement in Chemistry of students will mainly depend upon their Attitude and interest towards learning chemistry. Thus, teachers should take significant efforts to develop the interest and attitude of students towards learning Chemistry.
- Pre-service and in-service teacher training programs should focus on the importance of art integrated pedagogy in order to make schools healthier as par as compete with modern advancement in future.

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