



**CULTURALLY RESPONSIVE PEDAGOGY: INCORPORATING LOCAL RESOURCES AND INDIGENOUS PRACTICES TO IMPROVE STUDENTS' ACHIEVEMENT IN SECONDARY SCHOOL CHEMISTRY**

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**Abstract**

The study investigated the impact of culturally responsive pedagogy by incorporating local resources and indigenous practices, on students' achievement in secondary school Chemistry. The study adopted a quasi- experimental design, specifically pretest posttest non -equivalent control group. Two research questions and three null hypotheses tested at .05 level of significance guided the study. The population of the study comprised 435 (214 male and 221 female) SS1 students in all the public secondary schools in Umuahia North Local Government Area, Abia State. The sample size consisted of 115 (50 male and 65 female) students drawn from the target population using simple random sampling and purposive sampling techniques since gender is a variable in the study. The instrument for data collection, chemistry achievement test (CAT) was face and content validated by three experts in Science Education Department, Michael Okpara University of Agriculture, Umudike. The reliability coefficient of CAT was determined to be 0.74 using Kuder Richardson formula 20 (KR-20). Research questions were answered using mean and standard deviation while the null hypotheses were tested at .05 level of significance using ANCOVA. The findings of the study indicated a significant difference in students' achievement between those taught using local resources and indigenous practices and those taught with lecture method, in favour of the experimental group. Again, a non- significant difference in achievement was observed between male and female students exposed to local resources and indigenous practices, and the interaction effect of method and gender was also not significant. It was recommended that chemistry teachers should teach students with materials and examples from their immediate environment to achieve positive results.

**Key Words:** Local resources, indigenous practices, students' achievement, Chemistry

**Introduction**

Chemistry is one of the science subjects offered in Nigeria secondary schools. The knowledge of Chemistry is fundamental to everyday life activities such as cooking, cleaning, agriculture and medicine. It is also important for environmental sustainability, helping in waste management, pollution reduction, promoting the ethical use of natural resources and thereby contributing to national development. Despite the pivotal role of Chemistry in national



development, students' achievement in the subject continues to decline. The causes of low achievement in chemistry have been widely investigated by researchers and science educators and some factors have been identified such as the abstract nature of the subject, the use of non-innovative teaching methods and the disconnect between Western –based curriculum and local culture (Olorudare, 2014); inadequate facilities and resources, teaching methods and students' attitudes and misconceptions (Sibomana, Karegeya & Sentongo, 2021); as well as poor teaching methods,, lack of teaching experience, teacher's poor qualification and non use of instructional materials(Ojukwu, 2016) .Of all the factors militating against effective teaching and learning of chemistry concepts, Olorundare (2014) identified traditional teaching methods employed by teachers as the most recurring factor. Traditional methods of teaching such as lecture and demonstration methods are inappropriate for teaching chemistry because chemistry involves hands-on activities and therefore should be taught using methods that actively engage learners. Sibomana et al asserted that the use of effective strategies would improve engagement and overcome misconceptions. One of the concepts in chemistry in which students have misconceptions is acids, bases and salts. A study by Damanhuri, Treagust and Won (2016) reported that the concepts of acids and bases have continued to pose significant learning problems for students at all levels of schooling. Chiu in Demanhuri et al (2016) revealed widespread misconceptions in acids and bases among high school students. While 44% of high school students assumed that soapsuds are neutral simply because they are not harmful, 27% assumed that all acids and bases are toxic, reflecting a misunderstanding of the properties of acidic and basic substances, .A clear understanding of acids, bases and salts is essential , as it forms the foundation for mastering other related chemistry topics .For example, concepts in reaction kinetics often require comparing the reaction rates of strong and weak acids, which students cannot fully grasp without first understanding the nature of these substances. This challenge underscores the importance of adopting effective teaching methods that can help learners overcome misconceptions and make abstract chemical ideas more meaningful. In response to this, Uce and Ceyhan (2019) urged chemistry teachers to move away from traditional teaching methods to enhance meaningful learning. Recognising the need for a paradigm shift, science educators and researchers have advocated for and emphasized the integration of indigenous knowledge and practices as a way of revolutionizing science teaching and learning (Ademola, Okebukola,



Gbeleyi, Onuwugbeda, Agbaniwu, Uhuegbu & Mahadeje, 2022). A study by Vogelzang in Sibomana et al (2021) described a good teaching strategy as one which connects abstract chemical principles to societal contexts, research and practical applications. One way of achieving this connection is through the use of culturally responsive pedagogies.

Culturally responsive pedagogy aims to create equitable learning environments in which all learners irrespective of culture, language or background can learn and benefit optimally. Cooper and Voigt (2024) defined culturally responsive pedagogy, CRP, as a framework that may support College Chemistry Faculty in integrating social justice aims while also advancing equity within their own classrooms. Social justice is the reason behind efforts to make society just and inclusive for everyone, regardless of their background, status or identity. In a chemistry classroom, a teacher practicing cultural pedagogy might; use local resources; relate chemical processes to indigenous practices such as soap-making, dyeing and fermentation or incorporate examples and role models from students' cultural background in science history. Local resources can be natural, man-made or human. Natural resources are materials that come directly from nature and are available in the learners' surroundings, and can be used to make learning engaging and relatable. These natural resources provide raw materials used to teach Chemistry concepts ; for example, substances used to teach acids, bases and salts such as plant extracts, sea water, unripe fruits, wood ash, palm husk ash, oil, water samples and clay are naturally occurring resources. While natural resources are raw materials provided by nature, human creativity and innovation transform them into valuable man made resources. Man-made resources are artificial materials or tools created by humans using natural resources. They are easily accessible in the community and can replace expensive laboratory equipment. Man-made resources include; plastic bottles, plastic funnels, baby feeding bottles, metal cans and charcoal stoves. On the other hand, human resources are people in the community who have knowledge, skills or competencies that can help connect classroom learning to real-life applications. They include; teachers, laboratory technicians, laboratory scientists, and artisans from learners' environment. The effective utilization of local resources and indigenous practices provides learners with familiar and relatable experiences, which in turn enhances understanding, and eventually improves students' achievement.



Achievement is the measure of success a learner attains in an academic task or learning activity and can be measured through test scores, continuous assessment and examination results. Eze and Dinneya (2022) defined achievement as a measure of the extent to which the objectives of a course of study has been achieved by a learner. Aniodoh and Eze (2022) viewed achievement as a measure of the extent to which a learner has attained the objectives of an instructional process. Studies show that students learn more effectively when teachers relate lessons to their cultural backgrounds, everyday life experiences and indigenous practices. It is important to examine the influence of gender on the achievement of students.

Gender is a social distinction between males and females based on roles, expectations and responsibilities assigned by society. Gender is not biologically determined, nor is it synonymous with sex. Gender is learnt and socially determined. Gender influences opportunities and access to education and resources. Scholars such as Eze and Dinneya (2022) defined gender as a social construct that describes roles, behaviours and attributes that a society considers appropriate for males and females. Gender differences in learning have been acknowledged in educational research, as male and female students may respond differently to instructional approaches. Understanding these differences is important, especially when examining the impact of local resources and indigenous practices on students' achievement in secondary school chemistry. Having discussed the variables above, it becomes pertinent to review empirical evidence from past studies to identify consistencies and gaps in research findings.

Empirical studies on the impact of incorporating local resources and indigenous practices on students' achievement indicated conflicting results. While some researchers reported significant differences in favour of the experimental groups, showing that students taught with local resources and indigenous practices performed better than those taught using traditional methods. , others found non -significant differences in the mean achievement scores of experimental and control groups. For instance, Saibu et al (2024) reported that students taught separation techniques using indigenous vocational based practice performed better than those taught using lecture method , and in respect to gender, a significant difference was found. Again a report by Ugwu and Diove (2016) provided evidence that students taught with integration of indigenous knowledge and practices had a higher mean achievement score than their counterparts,



in the control group. There was no significant difference in the mean achievement scores of males and females and the interaction effect of method and gender was not significant. Oluboyo (2021) observed that students taught chemistry concepts using integration of indigenous knowledge and practices significantly achieved higher than those taught using conventional methods and gender had no significant influence on integration of indigenous knowledge and practices. Moreover, Oyakhirome and Oyeyemi (2025) reported that students taught separation techniques using ethno-chemistry based approach had significantly higher mean achievement scores and higher mean retention scores than their counterparts taught with lecture method.

On the other hand, Aladetuyi and Idika (2024) reported a non-significant difference in the mean achievement scores of students taught organic chemistry using case based learning with integration of indigenous knowledge and those taught using lecture method. Again, male students had a significantly higher mean score than their female counterparts. In view of the controversy observed in literature, the present study aims to contribute to existing knowledge by investigating the impact of incorporating local resources and indigenous practices on students' achievement in secondary school chemistry. Specifically, the study the study sought to ;

1. Determine the mean achievement scores of students taught acids, bases and salts using local resources and indigenous practices and those taught with lecture method.
2. Ascertain the mean achievement scores of male and female students taught acids, bases and salts using local resources and indigenous practices.

### **Research Questions**

1. What are the mean achievement scores of students taught acids, bases and salts using local resources and indigenous practices and those taught with lecture method?
2. What are the mean achievement scores of male and female students taught acids, bases and salts using local resources and indigenous practices?



## Hypotheses

H<sub>01</sub>: There is no significant difference between the mean achievement scores of students taught acids, bases and salts using local resources and indigenous practices and those taught with lecture method?

H<sub>0</sub>: The difference between the mean achievement scores of male and female students taught acids, bases and salts using local resources and indigenous practices is not statistically significant.

## Methodology

The study which investigated the impact of incorporating local resources and indigenous practices on students' achievement in secondary school chemistry was carried out in Umuahia North LGA, Abia State. The study adopted a quasi-experimental design, specifically pretest, posttest non-equivalent control group. The population of the study comprised 435 (214 male and 221 female) SSII students who offered Chemistry in all the public secondary schools in Umuahia North LGA. The sample of the study consisted of 115 students (50 male and 65 female) SSII students drawn from the target population using simple random sampling and purposive sampling techniques since gender is a variable in the study. Intact classes used for the study were assigned to control and experimental groups using simple balloting. A trial test was conducted by administering the CAT on ten students outside the sample of the study. The scripts were marked and scores collated were analysed using Kuder - Richardson formula 20, K-R(20) which yielded a reliability coefficient of 0.74. The control group was taught acids, bases and salts using lecture method while the experimental group was exposed to incorporation of local resources and indigenous practices. Students engaged in hands-on activities using locally available materials. For example, Students were asked to collect samples of wood ash, burnt plantain peel ash, burnt palm husk ash and burnt cassava peel ash from their surroundings. The filtrates obtained after mixing the ash samples with water and filtering served as base solutions. Students extracted natural acids from unripe fruits such as lemon, pineapple and orange and also prepared natural indicators (such as hibiscus extract known as zobo, turmeric, onion and beetroot) to test the alkalinity of the various filtrates and the acidity of the fruit juice. Blue and red litmus papers were



also used to test for acidity and alkalinity. Wood ash has multiple indigenous chemistry applications. For example, wood ash is used to make local black soap (saponification), used for food tenderizing such as akanwu ; used in making traditional dyes where ash solution serves as mordant, a binding agent that helps dye stick firmly to a material.

The instrument for data collection was Chemistry Achievement Test which was face and content validated by three lecturers in Science Education Department of Michael Okpara University of Agriculture, Umudike. The experiment lasted for four weeks. Regular teachers of the sampled schools were used as research assistants who administered both the pretest and posttest and also conducted the treatment after a brief training by the researcher. Extraneous variables were controlled by the researcher. Research questions were answered using mean and standard deviation while the null hypotheses were tested at .05 level of significance using analysis of covariance. A result is considered statistically significant if p-value is less than or equal to .05 but not significant if p-value is greater than .05.

## Results

**Research Question 1:** What are the mean achievement scores of students taught acids, bases and salts using local resources and indigenous practices and those taught using lecture method?

**Table 1: Mean and Standard Deviation of Students Taught Acids, Bases and Salts Using Local Resources and Those Taught Using Lecture Method.**

Groups	Pretest			Posttest			Mean Gain
	N	X	SD	X	SD		
Local Resources	65	13.38	1.85	17.42	1.17	4.04	
Lecture Method	50	12.0	1.39	13.83	1.23	1.83	

Data in table 1 indicates that the experimental group taught acids, bases and salts using local resources and indigenous practices had a pretest mean achievement score of 13.38 with a



standard deviation of 1.85, a posttest mean score of 17.42 with a standard deviation of 1.17 while the control group taught using lecture method had a pretest mean score of 12.0 with a standard deviation of 1.39, a posttest mean score of 13.38 with a standard deviation of 1.23. This suggests that students taught using local resources achieved higher than their counterparts in the control group.

Table 2 : Mean and Standard Deviation of Male and Female Students Taught Acids, Bases and Salts Using Local Resources and Indigenous Practices.

Group	Pretest		Posttest		Mean Gain
	N	X	SD	X	
Male	34	12.10	1.16	17.54	0.91
Female	31	12.09	1.03	17.50	0.89

Table 2 shows that male students taught acids, bases and salts using local resources have a pretest mean score of 12.10 with a standard deviation of 1.16, and a posttest mean score of 17.54 with a standard deviation of 0.89 while their female counterparts have a pretest mean score of 12.09 with a standard deviation of 1.03, and a posttest mean score. This implies that male students exposed to local resources and indigenous practices achieved slightly higher than their female counterparts. To find out if the difference is significant hypothesis two was tested.

Table 3: Summary of ANCOVA Showing Effects of Method and Gender on Students' Achievement in Acids, Bases and Salts.

Source Corrected	Sum of Squares	df	Mean Square	F	Sig.
Model	11600		5800	37.25	.000
Intercept	2623.713		2623.713	33.669	.000
Pre-test	9974.33		9974.33	127.99	.000
Method	2128.256		2128.256	27.31	.000
Gender	146.749		146.749	1.883	.070
Method x Gender	1.156		1.156	.015	.003
Error	25361.248	113	51.72		
Total	26474.048	115			
Corrected total	1112.800	114			



Data in table 3 show that the probability value ( $p = .000$ ) associated with the calculated F-value ( $f = 27.31$ ) for the effect of instructional method on students' achievement in acids, bases and salts is less than .05 set for the study. Therefore the null hypothesis is rejected. This implies that there is significant difference in the mean achievement scores of students taught acids, bases and salts using local resources and indigenous practices and those taught with lecture method. Again, the probability value associated with the calculated F-value (1.883) for the effect of gender on students' achievement in chemistry is .070. Since this value is greater than the .05 level of significance set for the study, the null hypothesis is not rejected. This implies that there is no significant difference in the mean achievement scores of male and female students taught acids, bases and salts using local resources and those taught with lecture method. Therefore the null hypothesis is not rejected.

### Discussion of Findings

The Analysis of Covariance results revealed a significant main effect of the instructional strategies on students' achievement in acids, bases and salts after controlling for their pretest scores. This indicates that the observed differences in posttest mean scores between the experimental and control groups were not due to chance but to the instructional methods used. Specifically, students taught using local resources and indigenous practices achieved higher adjusted mean scores compared to those taught through the lecture method. This suggests that exposing learners to familiar materials and examples from their environment enhanced meaningful learning. This finding supports the view that connecting classroom instruction to learners' immediate environment facilitates conceptual understanding. The result also aligns with previous studies (Ugwu and Diove, 2016; Oluboyo, 2021; Ezeanya, Oduke and Egbutu, 2023; Saibu et al, 2024 & Oyakhrome and Oyeyemi, 2025; ) that reported significant improvements in students' achievement when chemistry lessons incorporated local and indigenous knowledge systems. It also corroborates the constructive principle that learning becomes more effective when new concepts are built upon learners' prior experiences and environment. The study however contradicts the report of Aladetuyi and Idika (2024) who observed a non-significant difference in achievement of students taught organic chemistry using case based learning with integration of indigenous knowledge and those taught using lecture method.



Further, the ANCOVA result on gender showed no significant difference in the mean achievement scores of male and female students after controlling for pretest scores. This implies that both male and female students exposed to incorporation of local resources and indigenous practices benefited equally from the study. The result is consistent with the findings of Ugwu and Diove (2016) and Oluboyo (2021) who also reported that gender had no significant effect on students' achievement in chemistry when culturally responsive strategies were employed. This indicates that gender is not a determining factor in students' achievement when instruction is designed to be culturally relevant and engaging. However, the result contradicts Saibu et al (2024) and Aladetuyi and Idika (2024) who reported a significant difference in the achievement of male and female students exposed to culturally responsive pedagogy.

### **Conclusion**

The findings of the study revealed that students taught acids, bases and salts using local resources and indigenous practices achieved significantly higher than their counterparts taught using lecture method. This implies that when teachers relate chemical concepts to learners' cultural experiences and locally available materials, learning becomes more meaningful and practical. The study also established that had no effect on students' achievement, indicating that both male and female students benefited equally from the use of local resources and indigenous practices .

### **Recommendations**

Based on the findings of this study, the following recommendations are made:

1. Chemistry teachers should incorporate local resources and indigenous practices in teaching concepts such as acids, bases and salts to make lessons concrete and relatable.
2. Teacher training institutions should expose pre-service teachers to the use of local resources and indigenous practices as effective pedagogical strategies.
3. Further research should be carried out on the use of indigenous practices in other chemistry topics and science subjects to validate and generalize the findings of the study.



## References

- Ademola, I. A., Okebukola, P. A., Gbeleyi, O. A., Onuwugbeda, F. U., Agbaniwu, D., Uhuegbu, S. I. & Mahadeje, Y. A. (2022). Improving the academic achievement and problem solving skills of students : How effective is CTCA in nuclear chemistry? *NARST 95<sup>th</sup> Annual International Conference. Vancouver, British Columbia.*
- Aladetuyi, D. A. & Idika, M. I. (2024). Integration of indigenous knowledge into case-based learning strategy and students' achievement in organic chemistry in Ondo State Nigeria. *Proceedings of 64<sup>th</sup> Annual Conference of STAN, 96-100.*
- Eze, C. U. & Eze, G. N (2023). Impacts of tutorial and drill and practice modes of computer-assisted instruction on male and female students' achievement in secondary school chemistry. *Journal of the Science Teachers Association of Nigeria, 57, 49-54*
- Cooper, D. J.& Voigt, M. (2024). Advancing culturally relevant pedagogy in college chemistry. *Chemistry Teacher International, 2, 259-270.*
- Eze, G. N. & Dinneya, J. (2022). Enhancing Secondary School Students Achievement in chemistry using peer tutoring instructional strategy in Secondary schools in Abia State. *Rivers State University Journal of Education (RSUJOE), 25(2), 55-59.*
- Ezeanya, M. C., Odukwe, O. C. & Egbutu, R. N.(2023). Effects of ethno-chemistry instructional approach on secondary school students' academic achievement and retention in chemistry in Idemmili- North Local Government Area, Anambra State. *Journal of Educational Research on Children, Parents and Teachers, 4(2), 102-111.*
- Olorundare, A. S. (2014). Correlates of poor academic performance of secondary school students in the sciences in Nigeria. *Paper presented at the International Institute for capacity building in Higher Education , Virginia State University U.S.A.*
- .Oluboyo, S. O. (2021). Impact of indigenous practices on secondary school students Achievement in chemistry. *Unpublished B.Sc.(Ed), Lagos State University , Ojo, Lagos.*
- Oyakhrome, A. H. & Oyeyemi J.O. (2025). Impacts of ethno-chemistry-based approach on achievement and retention in separation techniques among secondary school chemistry students in Edo State, Nigeria. *Zamfara International Journal of Education (ZIJE). The Official Journal of the Faculty of Education, Federal University Gusau, Zamfara State, Nigeria, 5(1), 1 – 7.*
- Sibomana, A., Karegeya, C., & Sentongo, J. (2021). Factors affecting secondary school students' academic achievement in chemistry . *International Journal of Learning , Teaching and Educational Research, 20(12), 114-126.*
- Uce, M. & Ceyhan, I.(2019). Misconception in chemistry education and practices to eliminate them: Literature Analysis , *Journal of Education and Training Studies , 7(3), 202-208.*
- Ugwu, A. N. & Diove, C. I. (2016). Integration of indigenous knowledge and practices into chemistry teaching and students' academic achievement. *International Journal of Academic Research and Reflection , 4(4), 22-30.*