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Cultural resources, academic self-concept, and achievement of chemistry students in senior secondary schools of Calabar Municipality, Cross River State, Nigeria

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This paper investigated cultural resources, academic self-concept, and achievement of chemistry students in a senior secondary school in Nigeria. Research questions and hypotheses were formulated to direct the study. A quasi-experimental factorial design was used in this study, which had a sample size of 90 senior secondary chemistry students. The Academic Self-concept Questionnaire (ASCQ) and Chemistry Achievement Test (CAT) were used in this study. The reliability of ASCQ was done using Cronbach Alpha and it was 0.80 while the reliability of CAT was done using Kuder Richardson formula 20 and had a coefficient of 0.79. The results obtained were analyzed using a dependent *t*-test and analysis of variance (ANCOVA). Analysis of data showed that the academic self-concept of the students increased after using cultural resources and the experimental group gained more than the control. This study found that cultural resources made the learning of chemical concepts easy to comprehend as the materials were things that the learners were familiar with. This study recommends, among others, that teachers use cultural resources in teaching chemistry.

KEYWORDS

cultural resources, self-concept, achievement, students, enthochemistry

Introduction

Science and technology have become a home for humanity. While science deals with human beings' relentless effort to understand the universe through a systematic method of inquiry, technology is the application of science to solve humanity's problems as well as the exploitation of nature to enable the satisfaction of human needs (Izunwa, 2011). In today's world, advancement in science and technology determines to a great extent the level of development of a nation. Science subjects include chemistry, biology, and physics.

Chemistry deals with the structure, composition, and reaction of matter. It is considered as the central science as it is the basis of human beings' understanding of the universe. This understanding has let humans, through the knowledge of chemistry, manufacture and extract products. This ranges from foodstuffs, medicines, fuels, and metals (Malin, 2011). It is an essential subject in all courses including medical/pharmaceutical and health science, engineering, environmental technology, agriculture, and computer science/engineering (JAMB, 2021). The subject is germane in understanding what happens during cooking, how cleaning takes place, and processes in medicine and environmental issues (Helmenstine, 2020).

In as much as chemistry is very important for students' careers and for Nigeria to break even in science and technology, students have shown persistent poor achievement in chemistry in both external and internal examinations in secondary schools in Nigeria over the years. The performance of Nigerian students in chemistry in the May/June School Certificate Examinations of the West African Examinations Council (WAEC) between 2008 and 2014 showed that the percentage of credit passes was less than 50% for the majority of the years reviewed (Baanu et al., 2016). In this study, the academic performance of the student is measured by the marks the student has scored in the test administered.

Researchers have attributed the poor performance of students in chemistry in both external and internal examinations to the problem of a dearth of science resources at the secondary school level. Studies (Nkanu, 2009; Nbina and Obomanu, 2011) attribute the poor performance of students to the inability of the teachers to meet the demand of the WAEC practicals. The academic performance of the students could be an indication of several factors like the teachers, school environment, and school administration (Ololube and Kpolovie, 2012). In particular, Kpolovie (2013) and Kpolovie and Obilor (2013) attribute the poor performance of the students in chemistry to culture, family's socioeconomic background, and educational funding. Learning styles, study habits, and students' personalities are also some of the factors that contribute to the poor academic achievement of students in chemistry.

Academic performance is also attributed to the nature of academic self-concept, which is the way individuals view themselves in terms of their ability in an academic domain that invariably affects their academic performance (Marsh and Martin, 2011). According to the Shavelson model (Strein, 1993), academic self-concept may be categorized as descriptive (e.g., I like chemistry) and judgmental (e.g., I am good at chemistry). Generally, learners who are poor in a particular subject tend to develop low self-concept toward that subject (Elbaum and Vaughn, 2001). Academic self-concept, be it positive or negative, is developed as individuals relate to their environment (Ishak et al., 2010).

Self-concept

An important construct in education and psychology is self-concept, particularly academic self-concept. It is defined as the perception that one has toward oneself concerning school achievement (Reyes, 1984). Stephen's (2011) study of academic self-concept on students' academic performance revealed that students' higher academic performance was influenced by high self-concept and vice versa. Studies by Dramanu and Balarabe (2013) and Noriasih's (2013) indicated a positive relationship between academic self-concept and the academic performance of students. However, the work of Laryea et al. (2014), revealed a divergent finding where it was discovered that students' self-concept did not directly predict students' academic performance. Reaffirming the earlier studies, Grygiel et al.'s (2017) study on academic self-concept in Polish primary schools, demonstrated the influence of academic self-concept on academic achievement, and the study also indicated that past achievement influenced self-concept.

Frances et al. (2001) study on factors influencing academic self-concept discovered that the learning environment plays a major role in shaping students' academic self-concept and that it was formed both intrinsically and extrinsically. It could result from students' previous learning experiences and the learning methods and materials presented to the learners by the teacher (Blegur et al., 2018). An exciting learning environment can therefore stimulate students' positive academic self-concept.

Ethnoscience is the application of scientific concepts in the classroom that are indigenous to a particular tribe or culture (Aikenhead, 2011). It is made up of the following disciplines: "ethnoarchaeology, ethnoastronomy, ethnobotany, ethnolinguistics, ethnomedicine, ethnopedology, ethnopsychology, ethnopsychiatry, and ethnozoology and others" (Roth, 2019). Additionally, there are ethnophysics (Lawrence, 2017), ethnomathematics (Francois and Van Kerkhove, 2011), and ethnochemistry (Ajayi et al., 2017). Ethnoscience is not just an instructional tool but has been found to have a significant effect on students' achievement and interest when used in teaching science subjects (Adesoji et al., 2019).

When chemistry is studied using practices that are specific to a cultural group, dealing with their environmental problems and activities, and using their ideologies, it is termed ethnochemistry. In an ethnochemistry classroom (cultural chemistry), the teacher teaches chemistry by using students' culture and background in explaining chemical processes that are inherent in the students' environment. Ethnochemistry is also involved in the study of chemical practices found in a particular culture (Singh and Chibuye, 2016; Ajayi et al., 2017). Teaching chemistry using the cultural chemistry approach resulted in high academic performance of students in chemistry and a positive attitude toward studying chemistry (Siwale et al., 2020).

The literature reviewed (Adesoji et al., 2019; Siwale et al., 2020), pointed to the relevance of the environment in building academic self-concept. However, not much research has been done in the area of the use of indigenous chemical practices to boost chemistry students' academic self-concept. Studies on cultural practices and resources on the academic performance of chemistry students are scarce. There are also conflicting results on the influence of students' academic self-concept on their academic achievement. While some studies suggest academic performance can lead to a positive or negative self-concept, few others posit self-concept can lead to a positive or negative academic self-concept.

The purpose of this study was to investigate the effect of cultural resources, academic self-concept, and achievement of chemistry students in a senior secondary (SS2) school in the Calabar Municipality of Cross River State, Nigeria. In particular, the study set out to examine:

- The academic performance of SS2 chemistry students when taught utilizing and not utilizing cultural resources.
- The chemistry students' pre- and post-academic self-concept when taught using cultural chemistry resources.
- The interactive influence of academic self-concept on the academic performance of chemistry students taught distillation using the cultural practice resources and those taught without the strategy.

Conceptual framework

This study adopted the conceptual framework of culturally relevant pedagogy (CRP) developed by Neito (1999), Ladson-Billings (1994), and Gay (1994, 2000). The conceptual framework used five themes of culturally relevant principles. They are achievement and identity, excellence and equity, developmental applicability, instructing the full learner, and teacher-student associations.

Achievement and identity

In this theme, both student and teacher identities are taken into consideration, where identity is defined by their culture. Culture is the evaluation of the people of the world around them in terms of their perceptions and beliefs. How people see themselves can be seen through their cultures; language, behavior, interpretation of actions, and expectations from society are all sourced and shaped by culture. Gender, class, location, belief, ethnicity, exceptionality, and other diversities that define individuals are also embedded in the culture.

Identification of variation in cultures during teaching and learning is paramount to becoming a teacher with culturally relevant pedagogy. Thus, the knowledge and application of diversity as a result of knowing the students is imperative in providing an atmosphere for equal learning. Instead of viewing diversity in students as a problem, it can be viewed as a resource that can help learning and move between various cultures and languages equipping citizens to be members of a global community (Delpit, 1995). Consequently, the cultures of the local community are incorporated as learning tools during teaching and learning. This makes students feel authentic as their cultures are promoted.

Excellence and equity

When students' needs are provided for, equity is achieved. The needs are addressed when teachers believe that difference is good and that different instructions are necessary for some students, and when they adopt CRP to improve learning. Teachers can strive toward equity among students by accepting learners' cultural capital (Gay, 2000). Presuming to have an ethnic lens does not recognize equitable practices in the classroom. In addition, it is not possible for teachers to pretend not to see ethnic diversity. Different students have different needs and responding to those needs mandates that some teaching methods = are not plausible. Teachers who do not see diversity, have not seen students, and as such students' diverse educational needs will remain unaddressed (Gay, 1994). The inclusion of multicultural content in curriculum and instruction is equity and excellence.

Developmental applicability

In developmental applicability, the following concepts are important: teachers' and students' learning styles, and cultural differences in psychological needs (engagement, morale, motivation, collaboration). Therefore, developmental applicability takes into cognizance the prior cognitive level of learners. In addition, it involves the psychosocial developmental knowledge of students. Developmental theorists such as Piaget and Erickson have applied to young learners but there seems to be a gap in how the diversity of culture impacts on developmental applicability of older students. The cultural knowledge that students bring with them to school should be admitted, investigated, and used (Ladson-Billings, 1994). One of the objectives of developmental applicability is to help students achieve their goals through creative teaching methods and assessments. Teaching styles that include massive differences in culturally-based learning styles, as well as students learning preferences, are utilized. Good pedagogy is one in which students can relate what is taught in school to their environment.

Instructing the full learner

Students who attend schools come from different cultures and therefore are influenced by their initial socialization in the family and community. This shapes their academic identity. Teachers who use CRP need to be sensitive to how culture and ethnicity impact the academic, emotional, social, and psychological growth of students. The individual has a culture living in them. Students who attend schools have already learned how to see and do things according to their culture. The job of a CRP teacher is to scaffold those cultural experiences and use them to enable students to understand the concept under investigation in the classroom. When that is done, valuable knowledge has been emphasized by the culturally relevant teacher (Moll, 1992).

Student-teacher association

An imperative aspect of teaching and learning is the nature as well as the extent of the associations between teachers and students in enhancing student learning (Neito, 1999). Knowledge of the connection between communication, culture, and cognitive activities is important if a student-teacher relationship is to be successful (Gay, 2000). Prevention of misinterpretations of behavior, disrespect, and conflicts in schools is possible when CRP teachers know how to translate different cultural communication styles (Irvine, 1990, 2001).

When a school curriculum incorporates the culture of students into it, it is known as culturally responsive teaching. Community cultures are meaningfully connected to teaching and learning in culturally responsive teaching. It is designed to help enable students to make reasonable cultural associations and transmit academic knowledge.

Cultural chemistry practice in Ikom, Nigeria

In this study, the cultural chemistry practice of distillation of ethanol (ogogoro) known commonly as local gin was employed to teach distillation. In the course of the lesson, other chemical practices such as extraction, sedimentation, evaporation, condensation, vaporization, and fermentation were referenced. The process of local distillation of ethanol starts with the identification of oil palm trees. The tree is then pruned to remove all the branches. From the area where the fresh palm leaves are pruned and cut, liquids, called palm wine drops, ooze out. A container is attached to this area to collect the liquid that drips from the oil palm tree. The collected palm wine is emptied periodically to prevent spillage. The harvested palm wine is allowed to stand for about 3 weeks to allow complete fermentation.

The fermented palm wine is emptied into a pot and the lid is completely covered and heated gently. Pipes are connected at the uppermost part of the container that the liquid did not reach and directed to another pot/container that has cool water to cool the vapor coming from the pot with fermented palm wine. The vapor, which is ethanol, condenses as it passes through the pipe the pot contains cool water and is collected at the end of the pipe. This is shown in Figure 1.

Research design and methodology

A quasi-experimental 2 × 2 factorial design was employed in this research with treatment at two levels, experimental and control, and academic self-concept graded at two levels, high and low. A score of 20–40 on the academic self-concept scale was denoted low, and a score of 41–80 was denoted high. This design was chosen because it provided control over the independent variable and allowed its manipulation to establish the cause and effects of phenomena or events. This was done by administering treatment and having a control group (Onwioduokit, 2000).

$$\begin{array}{ccccc} Y & O1 & x1 & 02 & E \\ & O1 & x2 & 02 & C \end{array} \quad (1)$$

Where Y= academic self-concept; O1= pre-test; x1 teaching with cultural practices; x2 = teaching with conventional methods; 02= post-test; E = experimental group; C= control group.

Figure 2 indicates the picture of the design.

Table 1 represents the design of the study.

The experimental group was taught using cultural resources and the control was instructed in the normal way (without cultural practices resources). Both the experimental and control groups were evaluated at the beginning and the end of the research. The pre-academic self-concept and post-academic self-concept of the experimental group were evaluated before and after teaching them using cultural resources. A total of 90 students constituted the sample for the research, of which 42 students were placed in the experimental group and 48 students in the control.

Research procedures

Two instruments were employed for the research: Chemistry Achievement Test (CAT) and the Academic Self-Concept Questionnaire (ASCQ). The CAT, having a multiple-choice format with ten questions and each question having one correct answer and four distractors, was used for both pre-test and post-test validations. The initial CAT questions were reorganized in the post-test CAT so that the post-test CAT looked different. The CAT questions covered all the issues in the distillation process (Appendix A). Face and content validity for CAT was

FIGURE 1
The local way of ethanol distillation.

conducted, after which reliability was conducted. Evaluation experts examined the questions in the instruments to check for their appropriateness, relevance, and coverage of the traits under consideration. Five items were deleted because they were not suitable. Eventually, ten items were retained with some modification or revision.

For the reliability test, we used 25 SS2 chemistry students who were not part of the research group but were equivalent to the students in the study sample. Kuder Richardson's formula-20 was used for the analysis and the result was 0.79 as shown in Table 2.

When the reliability coefficient ranges between 0.50 and 1.00, the model is good enough to be used for research (Joshua, 2005). Similarly, an academic self-concept questionnaire (ASCQ) was constructed and validated before checking for reliability. The ASCQ consisted of 20 items with four options using a four-point Likert scale. The options ranged from "strongly agree" (4) to "strongly disagree" (1).

Affirmative items received scores ranging from 1 to 4, and nay items were given points in the opposite sequence, this gave the total attitude score that students obtained between 20 and 80 (see Appendix B). The minimum score for respondents was 20 and the maximum score was 80. The reliability test of the questionnaire was done using 25 SS2 chemistry students who were not part of the research group but equivalent to the students in the study sample. Analysis of data obtained using Cronbach's alpha for ASCQ for the reliability test was 0.80 and it was considered appropriate due to the small sample size.

Research questions and hypotheses

The key research questions explored in this study were:

1. What is the academic performance of SS2 chemistry students when taught utilizing and not utilizing cultural resources?
2. What are the chemistry students' pre- and post-academic self-concept when taught using cultural chemistry resources?

Research hypotheses: Three null hypotheses were stated as a guide for the study.

1. Chemistry students' pre- and post-academic self-concept does not significantly differ when taught using cultural resources.

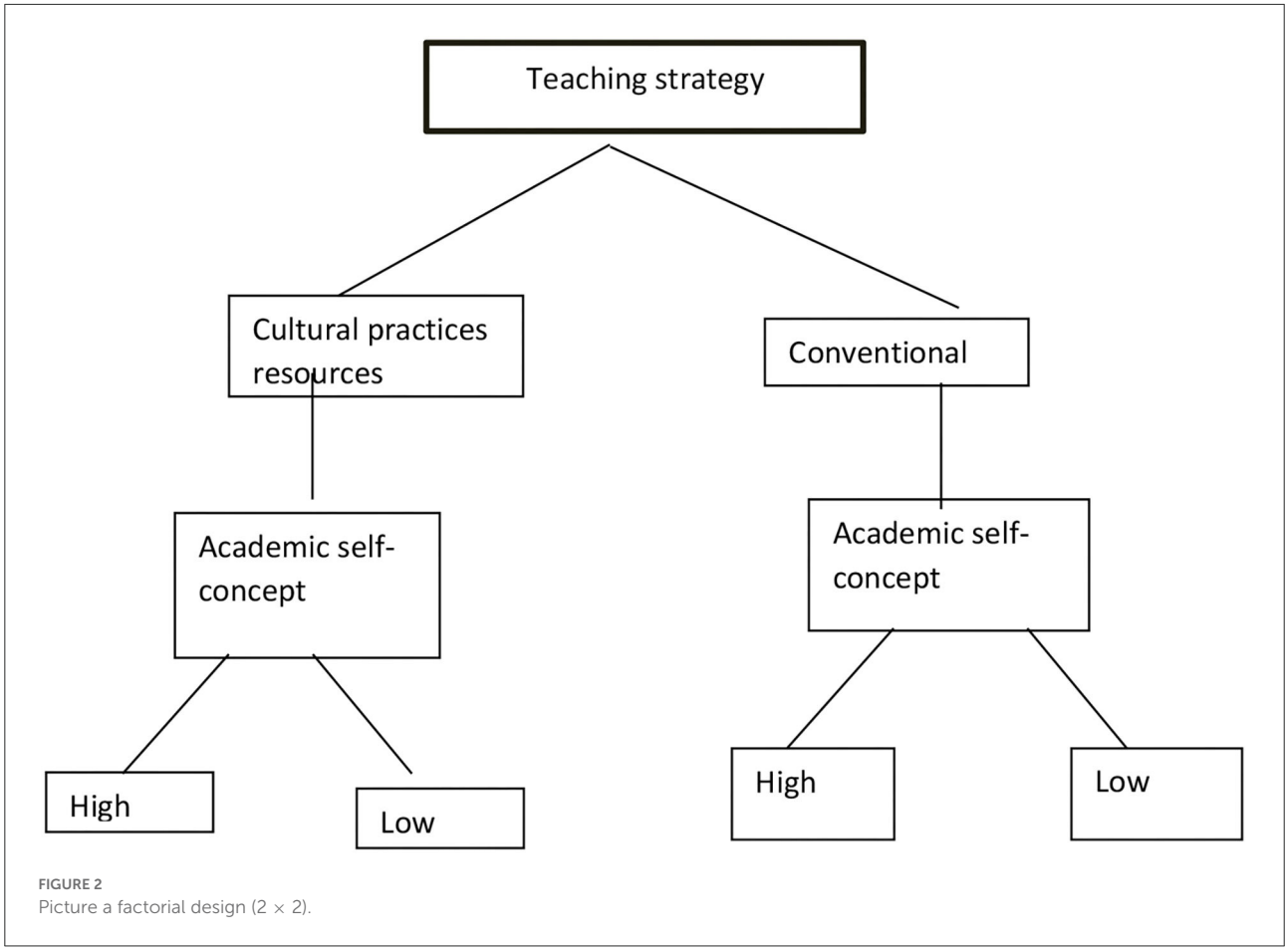

FIGURE 2
Picture a factorial design (2 × 2).

TABLE 1 The study design.

	Pre-test/pre academic self-concept	Treatment (4 weeks)	Post-test/post attitude
Cultural resources	Performance test/pre academic self-concept	X_{cr}	Performance test/academic self-concept test using cultural resources
control	Performance test/pre academic self-concept	X_{CL}	Performance test /academic self-concept test using conventional method.

I, intact class; Xcr, cultural resources; XCL, conventional learning.

2. There is no significant difference between the academic performance of chemistry students taught distillation utilizing and not utilizing cultural resources.

TABLE 2 Reliability coefficient of Chemistry Achievement Test (CAT) using Kuder Richardson formula −20.

	K	$\sum PQ$	S^2	R
CAT	10	1.94	6.68	0.79

3. There is no significant interactive influence of academic self-concept on the academic performance of chemistry students taught distillation using the cultural practice's resources and those taught without the strategy.

Sampling technique

The research was conducted in Calabar Municipality Local Government Area of Cross River State, Nigeria during the 2020–2021 academic session. Calabar municipality has a population of 486 SS2 chemistry students in 11 secondary schools. The choice of SS2 chemistry students was because students in SS2 have chosen chemistry as a subject in SS1 and would be writing their final exams in SS3 and therefore familiar enough

TABLE 3 Instruments used in this research.

Instrument	Collection technique	Number of items
CAT	Test	10
ASCQ	Questionnaire	20

with chemistry concepts to be used for this research. Two schools were randomly selected from a population of 11 schools using a simple random sampling technique. The two schools selected were also assigned randomly to the experimental group and control. In the experimental group, forty-two (n = 42) chemistry students were selected using a simple random sampling technique from a population of 60 SS2 chemistry students for the 2020–2021 school session. Forty-eight (n = 48) students were also arbitrarily selected from a population of 68 SS2 chemistry students for the 2020–2021 school session of another school about 20 km apart and the school formed the control. A total of 90 students were involved in the research. Both the experimental and control groups participated in the pre- and post-tests and pre-and post-self-concept tests.

Procedure for data collection

The ethical committee of the Secondary School Education Board of Cross River State approved the study. Participants were intimated about the aim of the research, and they were told that the exercise was purely for academic purposes and it was confidential and anonymous in terms of data collection and analysis. The respondents gave their consent and participated in the research. The instruments and techniques as well as the number of items used in this research are shown in Table 3.

This study was undertaken in the first semester of the 2020–2021 school session over a period of 4 weeks for cultural resources and conventional groups. The duration of 4 weeks was chosen to avoid maturation which when not taken care of can jeopardize internal validity. Teaching using cultural resources for the experimental group and the conventional method for the control group was done every week for 2 h. Before teaching, students in both groups were given a pre-test. The purpose of the test was to ascertain their initial competencies. The pre-academic self-concept test was administered to determine their academic self-concept before instruction with cultural resources.

In the experimental group, students were taken to a place in the neighborhood where local distillation was done (Figure 1). This was done after the pre-test and pre-academic self-concept were administered. Students were instructed to write a note on what they observed. The students returned to the classroom and the research assistants that were trained by the researchers taught students the concept of distillation using cultural resources. The conventional method was used to teach the control.

Treatment package

Cultural resources: Experimental group

The package included four sessions of 90 min per session for 4 weeks, designed to assist students to achieve high academic performance and academic self–concept.

The first session concentrated on the education of research assistants on the purpose of the research and how to use it. Pre-test and pre-self-concept were also administered. The next three sessions were for treatment. Participants were taught distillation using the cultural resources and the final session was designated for a post-test and post-self-concept test.

Data analysis

The data analysis was done by first marking and scoring the pre-test and post-test answer sheets for CAT and coding of ASCQ obtained from the participants. Data analysis was done using Statistical Package for the Social Sciences software (26). A trial test was done using 25 SS2 chemistry students that did not form part of the research group but were equivalent to the students in the research to conduct reliability. Cronbach's alpha coefficient was used for Likert scales and Kuder Richardson formula 20 was used for dichotomous scales. Data obtained from ASCQ and CAT was analyzed using inferential and descriptive statistics. Descriptive statistics used mean, standard deviation, and Std. Error Mean. Inferential statistics used sample t-test for ASCQ and analysis of covariance (ANCOVA) for CAT.

Results and discussion

Analysis of ASCQ data was done through descriptive statistics and inferential statistics. The descriptive statistics were mean and standard deviation and the inferential were sample t-tests and analysis of covariance. The first research question was: What is the academic performance of SS2 Chemistry students when taught with cultural resources, and when taught with conventional methods? The responses to the research question are presented in Table 4.

Table 4 shows that the mean score for academic performance for students taught distillation using cultural practices was 13.71. This was higher than the mean score for students taught using conventional methods, which was 10.81. This meant that chemistry students' academic performance when taught distillation using cultural practices and resources was higher than those taught in the conventional method.

The second research question sought to find out chemistry students' pre- and post-academic self-concept when taught

TABLE 4 Mean and standard deviation of academic performance of chemistry taught with cultural practices resources and conventional method.

Treatment	Mean	Std. deviation	N
Experimental	13.71	2.726	42
Control	10.81	2.703	48
Total	12.17	3.066	90

TABLE 5 Mean and standard deviation of pre- and post-academic self-concept.

	Mean	N	Std. Deviation	Std. Error Mean
Pre academic self-concept	23.37	43	6.694	1.021
Post academic self-concept	66.37	43	8.519	1.299

using cultural chemistry resources. The result of the analysis is presented in Table 5.

As indicated in Table 5, the mean post-test academic self-concept score ($M = 66.37$, S.D. $= 8.519$) was greater than the pre-test academic self-concept score ($M = 23.37$, S.D. $= 6.694$). These results clearly show that chemistry students' academic self-concept increased when they were taught using cultural practices and resources.

The first hypothesis stated thus: chemistry students' pre- and post-academic self-concept does not significantly differ when taught using cultural resources. To test this hypothesis, a sample *t*-test was used, and the results are presented in Table 6.

Results as indicated in Table 6, show that the post-test mean is higher than the pre-test mean, and a higher academic self-concept for chemistry, $t_{(42)} = 27.524$, *p*-value calculated was 0.000 at 0.05 level. It is also observable that SS2 chemistry students had improved in their test on academic self-concept when taught using cultural resources. The null hypothesis which stated that chemistry students' pre- and post-academic self-concept does not significantly differ when taught using cultural resources was rejected. This meant that there was a significant difference in the academic self-concept of chemistry students when taught using cultural practices and resources.

The second hypothesis was: chemistry students' academic performance does not differ significantly when they are taught distillation by utilizing and not utilizing cultural resources.

The results presented in Table 7 were used to test hypotheses 2 and 3.

Table 7 shows the *F*-value for treatment was $F_{(1,87)} = 20.979$, *p*-value was <0.05 for treatment (use of cultural practices resources and control classroom). With this result, the second hypothesis that stated that chemistry students' academic performance does not significantly differ when taught distillation by utilizing and not utilizing cultural resources was rejected. This implied that the academic performance of chemistry students was significantly different when taught utilizing and not utilizing cultural practices. The result for academic self-concept was $F_{(1,87)} = 23.072$, $p = <0.05$ it was significant.

The influence of academic self-concept when students were taught distillation using cultural practices resources and conventional methods on chemistry students' academic performance is denoted as treatment*academic self-concept in Table 7. Table 7 shows that the influence of academic self-concept when students were taught distillation using cultural practices resources and conventional methods on chemistry students' academic performance was $= F_{(1,87)} = 4.805$, $p = < 0.05$. The *p*-value obtained being lower than 0.05 implies that students' academic self-concept influenced their academic performance when taught utilizing and not utilizing the cultural practice's resources. The third hypothesis stating that there is no significant interaction of academic self-concept on chemistry students' academic performance when taught distillation utilizing cultural practices resources and those taught not utilizing was rejected. The influence of academic self-concept on the academic performance of chemistry students when taught utilizing cultural practices resources and conventional strategy as indicated in Table 7 provided 4.4% (0.044) of the overall discord in academic performance.

Discussion

This study investigated the academic performance of SS2 chemistry students when taught utilizing and not utilizing cultural resources (first research question). The mean score for academic performance for students taught distillation using cultural practices as shown in Table 4 was 13.71, which was higher than the mean score for students taught using the conventional method (10.81). These results implied that students taught using cultural resources gained more than those taught utilizing the conventional method. On the second research question relating to the chemistry students' pre- and post-academic self-concepts when taught using cultural chemistry resources, the results presented in Table 5 show that the post-academic self-concept means score ($M = 66.37$, S.D. $= 8.519$) was greater than the pre-test academic self-concept score ($M = 23.37$, S.D. $= 6.694$). These results indicated that the academic self-concept of students increased when they were taught using cultural practices and resources.

The first null hypothesis stating that chemistry students' pre- and post-academic self-concept does not significantly differ when taught using cultural resources was rejected. Results presented in Table 6 indicate that the post-test mean score

TABLE 6 Sample *t*-test for pre and post- academic self-concept score.

Variable	Mean	Std deviation	Std. error mean	*t*	Df	Sig. (2-tailed) $^*p < 0.05$
pre academic self-concept						
post academic self-concept	43.000	10.245	1.562	27.524	42	0.000

TABLE 7 A summary of 2 × 2 analysis of covariance of influence of treatment and academic self-concept on the academic performance of chemistry students.

Sources of variation	Type III Sum of Squares	df	Mean Square	*F*	Sig.	Partial Eta Squared
Corrected Model	257.459[a]	2	128.730	19.341	0.000	0.308
Intercept	2775.143	1	2775.13	416.961	0.000	0.827
Pre test	68.843	1	68.843	10.344	0.002	0.106
Treatment	139.627	1	139.627	20.979	0.000	0.194
Academic self-concept	118.865	1	118.865	23.072	0.000	0.201
Treatment *Academic self-concept	24.390	1	24.390	4.805	0.027	0.044
Error	577.041	87	6.443			
Total	14148.000	90				
Corrected total	825.400	89				

[a]R Squared = 0.308 (Adjusted R Squared =0.292) $^*p < 0.05$.

was higher than the pre-test mean score, and academic self-concept toward chemistry was significantly high as the sample *t*-test was $t_{(42)} = 27.524$, with a *p*-value of $p < 0.000$ at 95% confidence interval. Another look at that Table 6 shows that chemistry students in SS2 showed an enhancement in their test academic self-concept when taught using cultural resources. This improvement in their academic self-concept may be connected to the fact that cultural resources made them feel comfortable in the classroom. Their academic self-concept was boosted because the teacher was teaching from what they already know to what they do not know. This made them inquisitive thereby increasing their academic self-concept. Anxiety that follows when difficult topics are presented to students was taken away as what they know was right before them.

The findings of this work corroborate with other studies (Frances et al., 2001; Indra and Bitwell, 2016; Blegur et al., 2018; Siwale et al., 2020). These studies discovered that materials from the learner environment elucidated positive academic self-concept which leads to improved academic performance. It was also indicated that cultural resources being used during instruction made students have higher gains in academic performance, boosting their academic self-concept. This result is not unconnected to the fact that self-concept increases when a task to be done looks familiar. The fact that what learners already know is used in teaching chemistry makes them relaxed and learn better. Confusion in the learning structure is eliminated as what they know is used to link to new concepts. The findings of this paper agreed with the work of Kalebaila and Hamukale (2020) who discovered a link between activities in learners' culture and learners' attitudes as well as their academic performance. Students are motivated and develop high academic self-concept because of the inclusion of something familiar to them in the lesson.

The second hypothesis stated that there was no significant difference between the academic performance of chemistry students taught distillation utilizing and not utilizing cultural resources. The *F*-value in Table 7 was high $F_{(1,87)} = 20.979$, and the calculated *p*-value was <0.05 for materials used during teaching (utilization of cultural practices resources and conventional method). There was a rejection of the null hypothesis. This result implied that the use of cultural resources enhanced the academic performance of students. This increase in academic performance can be said to be a result of students feeling authenticated as their cultures are promoted. The CRP acted as a scaffold to enable students to have an understanding of the concept under investigation in the classroom. Good pedagogy is one in which students can transmit what is learned in school beyond the classroom. Students' ability to connect what happens in the classroom beyond the school may have increased their academic performance.

This finding corroborates earlier studies by Abumchukwu et al. (2021) that established the link between the high academic performance of students and ethno chemistry when it was used in classes. The researchers found that when concepts are related to the cultural activities, practices, and ideologies of the students, it brings the learning within the confines of students' existing scientific knowledge. The increase in students' interest in chemistry in the enthochemistry group that leads to improved

academic performance could be because the instruction leads to discussions about their cultural practices concerning chemistry. Other studies with similar findings include Oluwatosin et al. (2017), Okwara and Upu (2017), and Peni (2011), which showed that the experimental group taught using cultural resources had a significantly higher mean achievement score than their counterparts in the control group.

The third hypothesis tested the interactive influence of academic self-concept on the academic performance of chemistry students when taught utilizing and not utilizing cultural practices resources. Results presented in Table 7 indicated that the interaction between treatment and academic self-concept was significant as $F_{(1,87)} = 4.805$, $p = < 0.05$. These results imply that students' academic self-concept influences their academic performance when taught utilizing and not utilizing the cultural practice's resources. The third hypothesis which stated that there is no significant interaction influence of academic self-concept on the academic performance of chemistry students taught distillation using the cultural practice's resources and those taught not utilizing cultural resources was rejected. Academic self-concept influenced students' academic performance in chemistry when taught with cultural practices and resources by perhaps reducing their fear of failing chemistry and enabling students to learn effectively thereby leading to an increase in their academic performance.

Dramanu and Balarabe (2013) and Noriasih's (2013) findings showed a positive correlation between academic self-concept and the academic performance of students. The study of Grygiel et al.'s (2017) is also in agreement with this study as it revealed that academic self-concept influenced achievement. Cultural resources boosted students' attitudes toward the learning of distillation. Students' morale was high which led to the formation of a high academic self-concept due to the inclusion of known resources during teaching and learning. Cultural resources brought a keen view of phenomena in their natural setting which they have been exposed to for a time. This made them have learner's readiness. In the same vein, the study indicated that past achievement influenced self-concept. However, the study of Laryea et al. (2014) revealed a divergent view where it was discovered that students' academic self-concept did not directly predict students' academic performance.

Limitations

The researchers could not randomly assign students into the experimental and control groups as intact classes were used but merely labeled a school as experimental and another control. This study only used one topic in chemistry among a host of topics. Notwithstanding, the main purpose of the use of the cultural practice's resources was to utilize the instructional resources that learners are familiar with. Other variables such as class size, method, seating arrangement, and emotional intelligence could have influenced learners' negative academic self-concept before the utilization of cultural practices resources.

Conclusion

The conclusion derived from the findings of this study is linked to the favorable impact of cultural practices and resources on learners' academic performance and academic self-concept in chemistry. Linking cultural practices and resources related to what is taught in school to their environment reduces the abstract nature of chemistry concepts. Cultural practices and resources serve as a scaffold to enable students to understand the concepts in chemistry. Even though some practices like local distillation requires the students to move out of the classroom to the distillation site, students enjoyed the fact that learning was taking place in their neighborhoods.

Implications for further research

The following implications for further research may be suggested given the study's results: In learning chemistry, cultural practices and resources can be used to upgrade learners' academic performance in chemistry and boost students' academic self-concept toward chemistry. It has also shown the importance of teaching what students are familiar with.

Re-training of in-service teachers on sourcing and utilizing cultural resources in the classroom. A repository for various cultural practices and their resources in the local environment should be made available to develop topics in chemistry. Teachers from different cultures should work as a team to study cultural practices and resources that are not originally from their culture.

Researchers should study the impact of cultural practices and resources on other psychological variables such as self-awareness and emotional intelligence of students when a cultural resource is utilized in the classroom. The effect of teachers' characteristics and their utilization of cultural practices and resources on students' achievement can be conducted. Teachers' characteristics like gender, teaching experience, place of residence, and academic qualification could be focused on in future research.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

CN: design, writing, and editing. RO: data coding. JOU: review. HN: data acquisition. GE: data analysis. MO: conceptualization. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2022.896833/full#supplementary-material

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