COMPETENCIES REQUIRED BY CHEMISTRY TEACHERS FOR EFFECTIVE TEACHING AND LEARNING OF CHEMISTRY IN SECONDARY SCHOOLS IN ORUMBA SOUTH LOCAL GOVERNMENT AREA, ANAMBRA STATE

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Abstract

This study was designed to find out the competencies required by Chemistry teachers for effective teaching and learning of Chemistry in secondary schools in Orumba South Local Government Area of Anambra State. Three research questions were formulated to guide the study. The study adopted a descriptive survey research design. The population of the study was four hundred and thirty-two (432). This was made up of fourteen (14) Chemistry teachers and four hundred and eighteen (418) SS3 students offering Chemistry at West African Senior School Certificate Examination. Convenience sampling was used to select five (5) secondary schools in the local government area. Due to the manageable size of the population, there was no sampling. Self-structured questionnaire was the instrument used for data collection. One set of questionnaire was used for both the teachers and the students. The questionnaire contains a total of 51 items. The questionnaire was validated by three(3) Chemistry lecturers and the internal consistency of the instrument was established using Cronbach Alpha method and this yielded a reliability coefficient of 0.78. Data collected were analysed using mean and standard deviation. Based on the data analysed, the following finding were made: the competencies required by Chemistry teachers include: classroom instruction, classroom management, assessment and personal competencies, inadequate number of qualified teachers, lack of pedagogical skills of some Chemistry teachers, inadequate equipment for laboratory practical, poor funding among others were factors militating against Chemistry teachers' competencies, provision of adequate number of teachers, provision of good and equipped laboratories, employment of laboratory assistants, among others were some of the strategies for improving Chemistry teachers' competencies for effective teaching and learning. Based on the findings, some of the recommendations made include that the state government through the post primary school commission (PPSC) should ensure that adequate number of qualified Chemistry teachers are employed for secondary schools, the state government should make adequate provision for training and retraining of Chemistry teachers through in-service training, part-time programmes, seminars and workshops among others.

Keywords: Competency, Teachers, Chemistry, Teaching, Learning

Introduction

The teaching force of any educational system is an important factor in creating learning opportunities suitable to the students' needs and that of the society. For successful teaching to be achieved, the teacher is required to plan and implement instructions, to assist students in achieving specific pedagogical goals and objectives. Nourish *et al.* (2021), in support of the above stated that the teacher's professional quality and character, his educational qualification and professional competence are the bedrock that determine success of the schools set objectives and educational endeavor. Lawman (2017) observed that professional competence is the application of knowledge, attitude and skills acquired during professional training by individual for efficiency and effective performance of a task relevant to a specific interest. From the above, it means that professional competence is the knowledge, attitude and skills needed by the teacher to achieve teaching objectives. According to Odediran (2013), this is to ensure that effective teaching and learning takes place.

The professional trained teachers, that is those who have been trained in the art of teaching in tertiary institutions in the field is assumed to have acquired (from their teaching institutions) basic competencies required for effective teaching, which involves planning, implementation and evaluation of classroom instructions in specific subject areas. One such specific subject area is Chemistry which is a required subject for science students.

Chemistry is one of the science subjects taught at senior secondary school level. Ideally, all teachers, like the teacher of chemistry should attain mastery of all the basic instructional competencies before they are graduated from teacher education institutions (Ab Halim *et al.,* 2021). However, Nwagu (2022), pointed out that the institutions may not have enough facilities to ensure this and moreover, the assessment techniques in use in the school system may not be sensitive and valid enough to yield dependable measures of teachers' level of mastery of all the competencies. The performance of a chemistry teacher will increase if the teacher has all the competencies required to carry out his duties and responsibilities.

Teaching of Chemistry requires that the teachers should be equipped with basic technical and pedagogical competencies needed for instructional effectiveness and efficiency. This is because Chemistry is so fundamental to our world; it plays a role in everyone's life and touches almost every aspect of our existence in some way. Chemistry is essential for meeting our basic needs of food, clothing, shelter, health, energy and clean air, water and soil (http.//www.uwlax.edu>why-study. com).

Holistically, the objectives of Chemistry education in Nigeria is to provide students with basic knowledge in chemical concept and principles, through efficient selection of content and sequencing, showing Chemistry in its relationship with other subjects (http://www.globalacademicgroup.com)

Specifically, the objectives of teaching chemistry include : To develop an ability to observe, to analyze and to interpret objectively and to make rational decisions and to solve problems involving chemistry, to develop manipulative experimental skills, communicative skills used in the study of Chemistry, to determine which scientific investigations that depend on curiosity, honesty, persistence, critical thinking, willingness to suspend judgement and tolerance of uncertainty, to develop attitude on appreciation of the application of chemistry in daily life, To develop an understanding of the concepts and theories in Chemistry, to create an awareness of

the provisional nature that explains natural phenomena and the complex relationship between phenomena (https://aerodrive.ccchwc.edu.hk>aim). These objects are important for effective teaching and learning of Chemistry especially in secondary schools.

In secondary schools, the high level of knowledge and attitudes that should be manifested through teaching and learning of Chemistry in order to achieve these objectives are lacking. Akpan (2019), states that teaching of chemistry in most Nigerian secondary schools as presently done cannot encourage the realization of the above stated objectives of teaching chemistry. The situation according to the author is because many teachers of chemistry in secondary schools have not received adequate professional and technological training required for proficiency in their jobs.

Based on the above, the objectives of teaching Chemistry stated therein, it is very necessary that the teaching of chemistry in secondary schools should be handled by effective and competent teachers. The transformational power of an effective and competent teacher is something that cannot be over emphasized. There is a big link between teaching and students' academic achievement. It is a well-known fact that students perform better in subjects or courses where the teachers are effective and competent (Eliyawati *et al.* 2023).

An effective teacher demonstrates deep understanding of the curriculum, plans, teaches and assesses to promote students mastery of all the subjects. The teacher provides high quality instruction to increase students' achievement. An effective teacher provides a respectful, positive, safe and student centered environment. He collaborates with his colleagues to plan for effective and equitable instruction. Teachers' pedagogical content knowledge, belief and motivational orientation play important role in effective teaching (Bender, *et al.* 2015). The teacher also reflects and evaluates the effects of his choice, actions and assess the teaching results to be used as learning reflection (Loachapoka, 2019). Effective teaching is expected to be as a result of teacher's competency

Competency is the ability of an individual to have knowledge, skill or attitude that enables one to effectively perform the activities of a particular occupation or role to the required standard. Competency according to Mulder (2021) is the ability of individual to perform expertly or efficiently with little or no mistake. It is the ability of an individual to perform a job expertly. Furthermore, the author stated that competency is a measurable or observable skills, abilities and behaviors exhibited by an individual while performing a job. Nouri *et al.* (2021) stated that competency involves sufficiency of knowledge and skills that enable someone to act in a wide variety of situations. The author explained that competency is the application of all that one knows and can do. It is the precise way of differentiating superior from average performance. Ndem and Ogba (2014) stated that a competent person saves time, minimizes waste and as well work with error free results in specified activity.

The teacher's competence is measured through the performance and achievement of the students and these are hinged on the quality of instructional delivery/effective teaching. Effective teaching is the way a teacher employs instructional strategies and practices that are proven to lead to increase mastery of lessons. Better learning happens in a dynamic setting in which teachers demonstrate explicit instruction than in situations in which teachers do not actively guide instruction (Ab Halim *et al.* 2021). Effective teaching and learning is a method of teaching and learning that actively involve the learners in their own learning and personal development. Effective learning therefore suggests that the learner is active and strategic, is skilled in

cooperation, dialogue and creating knowledge with others, is able to develop goals and plans, monitors his/her own learning and is versatile across contexts.

For effective teaching and learning of chemistry in our secondary schools especially in Orumba South Local Government Area of Anambra State to take place, the teachers of Chemistry must be competent by having all the necessary skills a Chemistry teacher should have and by having a mastery of subject area.

Statement of the Problem

A lot of studies show that poor performance of students in Chemistry is attributed to the notion that chemistry is complex to learn thus making students to develop unfavourable attitude towards learning the subject. On the part of many teachers (incompetent) Chemistry is taught as a series of formulas to be memorized and applied just for the sake of learning as against teaching students to think critically and independently instead of accepting such knowledge without questions.

In teaching Chemistry, the teacher is the key. The teacher sets the pace and manipulates different variables. Teaching of chemistry in secondary schools is faced with a lot of challenges which include laboratory inadequacy, teachers attitude, time constraints for practical, none coverage of syllabus, class size, non-professionalism and environment among others (Obijekwu, 2016). The afore mentioned challenges can only be handled by a competent teacher. Unfortunately, a pilot visit to some secondary schools in Orumba South Local Government Area revealed that most teachers teaching chemistry in public schools need periodical workshops and seminars, where some are old with obsolete ideas and so on.

In view of the above therefore, the problem of this study is to determine the competencies required by Chemistry teachers that would enhance effective teaching and learning in secondary schools.

If this research on competencies required by Chemistry teachers for effective teaching and learning of Chemistry in secondary schools is not carried out to ascertain the necessary competencies and requirements a Chemistry teacher would have in secondary schools there would be inappropriate teaching and learning of chemistry, poor understanding of Chemistry by the students and this may lead to some students disliking chemistry as a subject and also poor performance of students in chemistry subject in West African Senior School Certificate Examination (WASSCE)

Purpose of the Study

The major purpose of this study is to determine the competencies required by chemistry teachers for effective teaching and learning of Chemistry in secondary schools in Orumba South Local Government Area, Anambra State. Specifically, this study is set to:

1. Identify instructional competencies required by Chemistry teachers for effective teaching and learning of Chemistry in secondary schools in Orumba South Local Government Area, Anambra State.
2. Identify the factors militating against Chemistry teachers' competencies for effective teaching and learning of Chemistry in secondary schools in Orumba South Local Government Area, Anambra State.

3. Determine strategies for improving chemistry teachers' competencies for effective teaching and learning of Chemistry in secondary schools in Orumba South Local Government Area, Anambra State.

Research Questions

The following research questions were posed for the study:

1. What are the instructional competencies required by Chemistry teachers for effective teaching and learning of Chemistry in secondary schools in Orumba South Local Government Area, Anambra State?

2. What are the factors militating against Chemistry teachers' competencies for effective teaching and learning of Chemistry in secondary schools in Orumba South Local Government Area, Anambra State ?

3. What are the strategies for improving Chemistry teachers' competencies for effective teaching and learning of Chemistry in secondary schools in Orumba South Local Government Area, Anambra State ?

Methodology

Area of the Study

The area of the study is Orumba South Local Government Area, Anambra State. The local government has thirteen (13) public secondary schools located in the following towns: Umunze, Ihite, Ezira, Isulo, Ogbunka, Owerre-Ezukala, Umuomaku, Ogboji and Nawfija.

Design of the Study

This study adopted a descriptive survey research design. A survey research design involves gathering information from a sample of or relevant population that is familiar with the ideas relating to the objectives of a study. This design was considered appropriate for the study because it involves the collection and analysis of data from the subjects (sample and population) through the use of questionnaire.

Population of the Study

The population of the study was made up of two categories of respondents, which consists of fourteen (14) Chemistry teachers in secondary schools in the local government and four hundred and eighteen (418) SS3 students offering chemistry at West African Senior Certificate Examination (WASSCE) in the 13 secondary schools. These gave a total of four hundred and thirty-two (432). This 432 constituted the population for the study. There was no sampling due to the manageable size of the population. The 432 was adopted as the sample for the study.

Instrument for Data Collection

The instrument for data collection was self-structured questionnaire. Only one set of questionnaire was used for the two groups of respondents, that is; chemistry teachers and SS3 students.

Section A was on background information of the respondents, section B was on competencies required by Chemistry teachers for effective teaching and learning and it has 25 items. Section C focused on factors militating against Chemistry teachers' competencies; this contains 12 items. Section D which is on strategies for improving Chemistry teachers' competencies for effective teaching and learning has 14 items. The instrument contains a total of 51 items.

Four (4) point rating scale was used to rate the responses of the respondents as follows: Highly Required (HR), Moderately Required (MR), Slightly Required (SR) and Not Required (NR) in section B of instrument. For section C and D of the instrument, four (4) point response scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) were used.

Validation of the Instrument

The instrument was subjected to face validation. The instrument was validated by three (3) lecturers, one lecturer from Department of Measurement and Evaluation Federal College of Education (Technical), Umunze and other two(2) lecturers from Department of Chemistry Education Federal College of Education (Technical), Umunze.

Method of Data Collection and Data Analysis

Personal contact approach was adopted in administering and collecting the questionnaire from the respondents.

The data collected was analyzed using mean. The mean was used to answer the research questions. The cut-off point was 2.50. It follows therefore that any mean rating of 2.50 and above was regarded as required/agree while any mean rating below 2.50 was regarded as not required/disagree.

Reliability of the Instrument

For the purpose of obtaining the internal consistency of the instruments, Cronbach Alpha reliability coefficient method was used, a reliability coefficient value of 0.78 was obtained.

Results

Table 1: Mean Rating of Responses of Chemistry Teachers and SS3 Chemistry Students on Competencies Required by Chemistry Teachers for Effective Teaching and Learning of Chemistry in Secondary Schools in Orumba South Local Government Area, Anambra State

S/N	ITEMS	$n_1=6$ $\bar{x}_1$	SD_1	$n_2=166$ $\bar{x}_2$	SD_2	Remark
1.	Have good knowledge of the subject matter	3.30	0.60	3.44	0.65	Required
2.	Ability to display enthusiasm and excitement for the subject	3.20	0.48	3.23	0.65	Required
3.	Ability to select the learning material	3.57	0.50	3.54	0.56	Required
4.	Ability to prepare good lesson plan	3.33	0.66	3.27	0.56	Required

5.	Informing the students about the criteria for success	3.40	0.50	3.33	0.61	Required
6.	Ability to use varied teaching methods, strategies and techniques	3.43	0.68	3.56	0.55	Required
7.	Ability to communicate in the language the students will understand	3.30	0.55	3.21	0.70	Required
8.	Ability to apply behavior reduction strategies	2.77	0.73	2.98	0.67	Required
9.	Ability to create safe learning environment	3.07	0.58	2.94	0.78	Required
10.	Ability to organize laboratory practical	2.90	0.88	2.95	0.81	Required
11.	Ability to state the laboratory rules and procedures	3.10	0.71	3.28	0.53	Required
12.	Ability to use proactive classroom management	2.73	0.74	2.56	0.80	Required
13.	Demonstrate to students the skills to be learnt	3.57	0.73	3.80	0.40	Required
14.	Making provision for students to practice the demonstrated skill/knowledge	3.57	0.85	3.55	0.56	Required
15.	Encouraging students to work as a team	3.73	0.45	3.63	0.58	Required
16.	Having positive regard for students	3.60	0.67	3.75	0.45	Required
17.	Ability to be flexible and capable to adjust to novel situations	2.93	0.98	2.82	0.93	Required
18.	Ability to collaborate with other teachers	3.60	0.56	0.68	0.50	T=Required S=Not required
19.	Ability to maintain professional appearance	3.47	0.68	3.36	0.76	Required
20.	Ability to impart the necessary skills to the students	3.50	0.63	3.55	0.57	Required
21.	Ability to plan and organize field trips/ excursions for students.	3.47	0.68	3.55	0.53	Required
22.	Ability to evaluate students using process and product	3.30	0.70	3.51	0.56	Required
23.	Ability to assess students using non-referenced method	3.27	0.69	3.43	0.58	Required
24.	Ability to assess students using criterion referenced method	3.53	0.63	3.76	0.44	Required
25.	Ability to make provision for remedial opportunities for the students	3.47	0.57	0.76	0.46	T=Required S=Not required
	Grand total	83.11	16.43	73.44	15.19	Required

$\bar{x}_1$ = Mean responses of chemistry teachers, $\bar{x}_2$ = Mean responses of SS3 chemistry students, SD_1 = Standard deviation of chemistry teachers mean ratings, SD_2 = Standard deviation of SS3 chemistry students' mean ratings.

Table 1 that has 25 items shows that the teachers mean responses ranged from 2.73 to 3.73 and all fell under the response category of required. This means that the teachers accepted all the items as competencies required by Chemistry teachers for effective teaching and learning of Chemistry. On the part of the chemistry students, items 18 and 25 had mean ratings of 0.68 and 0.76 respectively. These fell under response category of not required, which means that the students did not accept ability to collaborate with other teachers and ability to make provision for remedial opportunities for the students as competencies required by chemistry teachers.

Table 2: Mean Ratings of Responses of Chemistry Teachers' and SS3 Chemistry Students on Factors Militating Against Chemistry Teachers' Competencies for Effective Teaching and Learning of Chemistry in Secondary Schools in Orumba South Local Government Area, Anambra State.

n_1 = Number of chemistry teachers, n_2 = Number of SS3 chemistry students, $\bar{x}_1$ = Mean responses of chemistry teachers, $\bar{x}_2$ = Mean responses of SS3 chemistry students, SD_1 = Standard deviation of chemistry teachers mean ratings, SD_2 = Standard deviation of SS3 chemistry students' mean ratings.

S/N	ITEMS	$n_1=6$ $\bar{x}_1$	SD_1	$n_2=166$ $\bar{x}_2$	SD_2	Remark
26.	Inadequate number of qualified chemistry teachers in secondary schools	3.73	0.45	3.74	0.44	Agree
27.	Lack of pedagogical skills of some chemistry teachers	3.55	0.50	3.63	0.51	Agree
28.	Poor laboratory environment	3.50	0.52	3.46	0.53	Agree
29.	Inadequate facilities and equipment in the laboratories	3.61	0.54	3.49	0.61	Agree
30.	Absence of chemistry laboratory assistant/attendant in secondary schools	3.55	0.61	3.15	0.69	Agree
31.	Inadequate time for laboratory and practical demonstrations.	3.52	0.60	3.49	0.61	Agree
32	Shortage of chemistry textbooks in the school library	3.58	0.58	3.60	0.56	Agree
33.	Lack of commitment to duty on the part of the teacher	3.66	0.47	3.55	0.55	Agree
34.	Poor remuneration of science teachers in general and chemistry teachers in particular	3.64	0.48	3.61	0.52	Agree
35.	Inadequate funding of secondary schools and science subjects	3.60	0.53	3.50	0.55	Agree
36.	Absence of field trips in teaching chemistry in secondary schools	3.60	0.59	3.46	0.55	Agree
37.	Lack of motivation of chemistry teachers in secondary schools	3.49	0.54	3.64	0.53	Agree

ratings.

Table 2 shows that all the 12 items were accepted by the respondents (Teachers and Studets) as factors militating against Chemistry teachers' competencies for effective teaching and learning of Chemistry in secondary schools. The mean responses of the teachers ranged from 3.49 to 3.73 while that of the students ranged from 3.15 to 3.74; all fell under the response category of 'Agree'.

Table 3: Mean Ratings of Responses of Chemistry Teachers and SS3 Chemistry Students on Strategies for Effective Teaching and Learning of Chemistry in Secondary Schools in Orumba South Local Government Area, Anambra State

S/N	ITEMS	n_1=6 $\bar{x}_1$	SD_1	n_2=166 $\bar{x}_2$	SD_2	Remark
38.	Provision of adequate number of qualified chemistry teachers in secondary schools	3.62	0.62	3.57	0.54	Agree
39.	Provision for training and retraining of chemistry teachers through in-service and part-time training, seminars and workshops	3.49	0.74	3.49	0.59	Agree
40.	Provision of good chemistry laboratories in schools	3.44	0.60	3.49	0.53	Agree
41.	Provision of adequate laboratory equipment and facilities for teaching of chemistry	3.34	0.72	3.42	0.59	Agree
42.	Employment of laboratory assistants/attendants in secondary schools	3.42	0.60	3.58	0.50	Agree
43.	Allocation of adequate time for laboratory practical	3.42	0.56	3.63	0.49	Agree
44.	Use of field trips to teach and motivate students	3.46	0.60	3.57	0.50	Agree
45.	Use of field trips to improve teachers competencies	3.44	0.58	3.43	0.59	Agree
46.	Teachers to use variety of teaching methods and strategies	3.62	0.54	3.61	0.52	Agree
47.	Chemistry teachers welfare to be given utmost attention vis-à-vis promotions and payment of salaries	3.33	0.69	3.57	0.52	Agree
48.	Science and hazard allowances to be paid to chemistry teachers	3.48	0.62	3.55	0.45	Agree
49.	Provision of adequate fund for chemistry teaching	3.62	0.55	3.61	0.52	Agree
50.	Parents Teachers Association to assist in the provision of laboratories, laboratory equipment and facilities for chemistry teaching	3.48	0.57	3.64	0.51	Agree
51.	Heads of schools to source for fund from host communities and philanthropists	3.54	0.57	3.55	0.63	Agree

n_1 = Number of chemistry teachers, n_2 = Number of SS3 chemistry students, $\bar{x}_1$ = Mean responses of chemistry teachers, $\bar{x}_2$ = Mean responses of SS3 chemistry students, SD_1 = Standard deviation of chemistry teachers mean ratings, SD_2 = Standard deviation of SS3 chemistry students' mean ratings.

Table 3 shows that both groups of respondents accepted all the items as strategies for improving Chemistry teachers' competencies for effective teaching and learning of Chemistry in

secondary schools. While the mean responses of teachers ranged from 3.33 to 3.62 that of the students ranged from 3.42 to 3.63. These fell under the category of 'Agree'.

Discussion of Results

The findings of this study in accordance to research question one identified four major areas of competencies required by Chemistry teachers for effective teaching and learning of Chemistry which include: classroom instruction, classroom management, assessment and personal competencies. In agreement with these findings Nouri *et al.* (2021), stated that 21st century teaching competencies include teachers knowing content they teach, facilitating learning for their students and using variety of methods and materials suited to the needs of the students. These findings are in tandem with Bender *et al.* (2015) who stated that good classroom management contributes 20% in students' achievement, when classroom rules and procedures are systematically applied.

The findings of this study as regards research question two revealed that there are inadequate number of qualified Chemistry teachers in secondary schools and lack of pedagogical skills of some Chemistry teachers, poor laboratory environment, inadequate facilities and equipment in the laboratories and inadequate time for practical demonstration. These findings are in conformity with Ossai (2018) who pointed out that teachers without pedagogical training/culture are used to teach science and technical subjects. These findings are in line with Copriady (2014) who stated that due to ill equipped laboratories in secondary schools that laboratory practical will be poorly and shabbily handled.

The findings from research question three showed that provision of adequate number of qualified Chemistry teachers' in secondary schools and provision for training and retraining of Chemistry teachers through in-service and part-time training, seminars and workshops are important in improving Chemistry teachers' competencies. These findings conform with Nessibayeva (2012), who stated that there should be opportunities for retraining of teachers who are already in the field. Other findings of this study include provision of adequate laboratory equipment and facilities for teaching of chemistry, use variety of teaching methods and strategies in their instructional delivery, employment of laboratory assistant/attendants in secondary schools. The study further identified the allocation of adequate time for laboratory practical. This finding is in agreement with Ejidike (2015), who stated that for teaching of science subjects to be meaningful in secondary schools, adequate time must be allocated for the practical work to ensure effectiveness. The study further identified chemistry teachers welfare to be given utmost attention vis-à-vis promotion, payment of salaries, payment of science and hazard allowances. These findings are in consonance with Eliyawati *et al.* (2023), who opined that hazard allowances should also be introduced in addition to the conventional science allowances and that this will surely boost the morale of science teachers in general and chemistry teachers in particular.

Conclusion

Based on the findings, the following conclusions were drawn:

There are competencies required by Chemistry teachers for effective teaching and learning of Chemistry in secondary schools, these competencies are grouped into four which include: classroom instruction, classroom management, assessment and personal competencies. There are also factors militating against Chemistry teachers' competencies as identified in this study. Some

of these factors can be surmounted if the strategies and recommendations made in this study are looked into and adopted.

With the competencies identified and limiting factors removed, it is hoped that the Chemistry teachers' instructional delivery would be effective and this in turn will enhance effective learning on the part of the students.

Recommendations

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

1. The state government through the Post Primary School Commission (PPSC) should ensure that adequate number of qualified Chemistry teachers are employed for secondary schools
2. The state government should make adequate provision for retraining of chemistry teachers through in-service training, part-time programmes, seminars and workshops
3. The principals of schools should ensure that the school timetable is structured in such a way that it allows adequate time for practical demonstration and laboratory practical.
4. The state government should make provisions for the needed equipment and facilities in the chemistry laboratories
5. To make teaching of Chemistry less cumbersome for the teacher especially in the area of practical, laboratory attendants/assistants should be employed for secondary schools
6. Apart from payment of salaries, normal allowances, hazard and science allowances should be introduced as this will help boost the morale of Chemistry teachers

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