Journal of Educational Research and Reviews
Vol. 1(1), pp. 1-8, August 2013
Research Paper

Relationships between students' task engagement and learning outcomes in chemistry

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Accepted 13th July, 2013

Abstract. To promote Science and Technology at the classroom level, for national growth and global competitiveness, nations are now paying more attention to students' active participation in science learning. This study investigated science students' task engagement in relation to their learning outcomes (attitude and achievement) in Chemistry. A stratified sample of 60 students drawn from 10 schools was used in the study. The Student Task Engagement Record, a classroom observation instrument, was used to record students' on-task and off-task behaviour/engagement during chemistry lessons. At the end of the 6 weeks observation period, the Chemistry Achievement Test and Chemistry Attitude Questionnaire were administered to ascertain students' chemistry achievement and attitude respectively. The engagement scores of the students were correlated with their achievement and attitude scores using Pearson's product moment correlation. Students' task engagement was found to have significant, positive correlation ($r = 0.74$) with achievement in chemistry; and non-significant negative correlation ($r = -0.03$) with attitude toward chemistry. It was therefore recommended that strategies for promoting task engagement should be taught and promoted in schools. Both practicing and trainee science teachers should build capacity in fostering engaging learning activities.

Keywords: Science Education, engagement, chemistry achievement, learning outcomes.

INTRODUCTION

Advancement in Science and Technology has become a global phenomenon; science now permeates almost all facets of human endeavor, and nations are increasingly investing enormous resources into the 'doing' and 'learning' of science for development and global competitiveness. Consequently, scientists and science educationists are today more recognized as playing crucial roles in advancement. At the classroom level, the science teacher's role in fostering students' active involvement in 'doing' and 'learning' of science is seen as crucial for students' achievement in sciences, and the overall sustainable advancement of science (Adesoji et al., 2003). As teachers are key players in fostering student engagement for academic success (Akey, 2006), so also the students themselves must play their part, demonstrate commitment, persistent, and willingness to learn.

Several studies (Akey, 2006; Carini et al., 2006; Christenson et al., 2012; Orji, 2011; Taylor et al., 2011) have described students' involvement in the learning process and its relation to academic achievement and attitude. They used the term 'student engagement' to connote not only students' attention in class but also their cognitive, psychological and social involvement or efforts/pursuits in learning task. Akey (2006) explored the influence of student engagement and perceived academic competence on achievement in reading and mathematics. He found that both engagement in school and students' perception of their own academic competence positively influenced achievement in mathematics for high school students. Similarly, Carini et al. (2006) found many measures of student engagement positively, though weakly, correlated with such desirable learning outcomes as critical thinking and grades. Student engagement does not only prevent dropout but improves learning outcomes (Christenson et al., 2012). Thus, according to Taylor et al. (2011), we need to change how we teach and what we teach in order to encourage student engagement.

Encouraging or fostering student engagement is predicated upon the understanding and operationalization of student engagement. While referring to students' engagement as their mental and social participation in learning tasks, Orji (2011) operationalized it with sociological factors of feeling, belonging, cooperation and group work; psychological factors of interest, personality and motivation; and situational factor (institutional classroom variables). This was based on the assertion that human is made up of cognition, that is, has cognitive ability, and is a social being (Piaget, 1978; Knowles, 1978). Sociological indicators of student engagement include 'cooperation', 'involvement', 'participation', 'taking-part-in' and 'attendance' in an organized social activity, influenced by the need to be part of an activity, pressure from peers, expectations and values (Cangelosi, 1993; Courtney, 1989 in Orji, 2011). Other studies (Appleton et al., 2006 & 2008) focused on psychological indicators (interest personality, motivation) such as 'interest', 'personality', 'motivation', 'involvement', 'attentiveness', 'student initiative', 'curiosity', and 'enthusiasm'. There are also studies (Cangelosi, 2008; Smith et al., 2005) that focused on ecological, situational or institutional explanation of student engagement. They highlighted the importance of a conducive classroom climate and instructional management procedures for the promotion of students' task engagement.

Chapman (2003) reviewed studies which made use of time-based indices such as 'time-on-task' to describe overt student engagement (Brophy, 1983; Fisher et al., 1980; McIntyre, et al., 1983) and those that described covert cognitive engagement (Dintrich and De Groot, 1990; Schranben, 1992). He described students' cognitive, behavioral and affective task engagement measures using 'time-on-task', 'involvement' and 'willingness to participate' index. According to him, student engagement includes: the extent to which students were attentive in class and expending mental effort in the learning task, that is their use of cognitive and meta-cognitive strategies; the extent to which students actively respond to the tasks (asking relevant questions, solving task-related problems, and participating in relevant discussions with teachers/peers); and the level of student's investment in learning and their emotional reactions to the learning tasks (e.g. high levels of interest or positive attitudes towards the learning tasks). He described student self-report measures, checklists and rating scales, direct observations, work sample analysis, and focused case studies as instruments for assessing student task engagement. Direct observation schedule was used in this study to measure overt engagement index of students in science classroom. This is similar, yet different from Beasley (1983) study of overt student involvement behaviours in small group laboratory setting with students as 'definitely in', 'probably in', 'waiting' and 'out' of the task. The engagement index included: student performance of requested activity, listening, watching, answering questions, writing note, watching teacher, watching demonstration, manipulating apparatus, collating data, reading and solving problems and summarizing material.

Orji (2011) utilized index of participation that emphasize 'effort-on-task' rather than 'time-on-task'. He noted that measurement of student engagement/participation could be on individual basis, that is, by judging acts of individual students who performed them or on whole-class or group basis, measuring total number of students involved in required task. He also used terms such as 'intensity', 'forms' and 'degree' to describe extent of participation in learning. Using questionnaires, checklists and participation chart/scale, he operationalized engagement using index of motivation, interest, activity, appearance, attentiveness, attitude/values, concern for skill, contribution to group discussions, earliness to class, emotional balance, helpfulness in class, homework submission, independent study, influence popularity, initiatives, interest in study, motivation, outspokenness, regularity of attendance, responsibility, self-control and social interaction.

Student active learning, which posits students' conscientious responsibility for their learning, is especially relevant in science learning considering the nature of science. According to Science Council (2013), science is a process of discovery of the natural and social world or "the pursuit and application of knowledge and understanding of the natural and social world" (par. 1). Strategies to promote active student engagement have been researched (Taylor et al., 2011; Orji, 2006; Herr, 2007). According to Taylor et al. (2011), student engagement is improved by 'Interaction', 'Exploration', 'Relevancy', 'Multimedia', 'Instruction', and 'Authentic assessment'. We need to change how we teach and what we teach in order to encourage student engagement. Herr (2007) described a set of strategies that posits the responsibility for learning with the student. These include discovery learning, problem-based learning, experiential learning, and inquiry-based instruction. He added discussion, debate, student questioning, think-pair-share, quick-writes, polling, role playing, cooperative learning, group projects, and student presentations as learner-driven activities. Incorporated in science class, these enrichment activities foster student engagement.

Student engagement has been studied in relation to both student and teacher variables. Orji (2006) reviewed studies (Capie and Tobin, 1981; Johnson and Butts, 1983; Ramadas and Kulkarni,1982; Shymansky and Penick, 1977; Tobin, 1986) that investigated science students'

engagement in relation to student variables such as students' self-perception, competency belief, problem-solving, process-skills activities, cooperative/
group learning, experimentation, use of teaching aids, attitude and locus of control, reasoning ability, and science achievement. He also reviewed studies (e.g. Okebukola and Ogunniyi, 1986) that related student engagement to teacher variables such their classroom management and direct/indirect verbal behaviours. In this study, science students' task engagement is investigated in relation to achievement in chemistry as well as attitude towards chemistry. Here, the term attitude refers to students' feelings or mind-set towards 'chemistry' as a subject as well as the 'learning of chemistry'.

Problem and objective of the study

Revamping the primary and secondary schools science base for national advancement and global competitiveness has been the concern of many developing nations. In Nigeria, there has been intervention projects such as the [1]STAN Projects, [2]STEP-B projects, [3]SMASE Project, Science and Mathematics Competitions, and Science-Technology Clubs introduced in Schools to promote science, technology and mathematics education. Recently, National MDGs and STEP-B Offices released funds to the Nigerian Educational Research and Development Council (NERDC) to review of the basic and senior secondary education science curricula and development of teachers' guide to ensure effective delivery of the curricula.

These interventions notwithstanding, education stakeholders including examinations bodies are highlighting poor implementation of policies and projects at the classroom level with the resultant negative effects on students' achievements. For example, the West African Examinations Council (WAEC) and National Examinations Council (NECO) lamented the poor student performances in public examinations (Oranu, 2012). Report of June 2009 NECO exams (Mosadomi, 2010) showed that out of 1,137,906 candidates only 24.9, 44.17, 30.4 and 37% scored credit and above in Mathematics, Biology, Physics and Chemistry, respectively. A 2012 NECO result report (Nigeria Technology Guide, n.d.) revealed still a low credit rates for physics (0.26%) and Chemistry (30.17%). Oranu (2012) attributed the students' poor performances to poor remuneration of teachers, degrading education facilities, poor monitoring of innovative policies and programmes, too much emphasis on theoretical knowledge, and the inhibiting socio-cultural beliefs and practices of students. He also highlighted students' declining willingness/interest and engagement in school which results in 45% students' student dropout rate.

Low attitude and poor achievement in science have been of concern to educationists and researchers. More worrying are students' recurring disengagement, ill-motivation, absenteeism and disinterestedness during chemistry lessons which tendencies are said to impact negatively on their school success. These problems and students' declining achievement in chemistry is the concern of this study. In Nigeria and other developing countries, stakeholders in science education want to know the cause of the incessant poor performance in chemistry and whether it is in any way related to the nature and extent of students' involvement or engagement in science learning tasks. Is chemistry achievement in any way related to the supposed disinterestedness in school? And, are students having negative attitude towards chemistry or learning of chemistry, and how involved are they during classroom chemistry lessons?

This study, therefore, focused on science students' task engagement and its relation to students' achievement and attitude in chemistry. It sought to obtain information about the pattern and nature of student involvement in science learning; as well as to ascertain the relationship between students' 'on-task'/'off-task' behaviours, their achievement in chemistry and attitude towards chemistry.

Research questions

This study sought to address the following questions:

1. What is the nature and extent of students' task engagement in chemistry?
2. What is the relationship between students' task engagement and
i. Achievement in chemistry?
ii. Attitudes towards chemistry?

Hypotheses

The following hypotheses were tested in the study:

HO_1: There is no significant relationship between students' engagement and their achievement in chemistry
HO_2: There is no significant relationship between students' engagement and their attitude towards chemistry

METHODOLOGY

Research design

The study used correlational design. According to Cherry

[1] STAN means Science Teachers' Association of Nigeria
[2]STEP-B means Science, Technology and Engineering P
[3]SMASE means Strengthening Mathematics and Science Education Project sponsored by Japan International Corporation - JICA

(2013), correlational studies are used to look for relationships between variables. She described three types of correlational studies: Naturalistic observation, the survey method and archival research. This study employed both naturalistic observation and survey method. While classroom observation was used to study students' task engagement, survey and questionnaires were used to ascertain students' achievement and attitude towards chemistry. This design allowed the researcher to investigate the nature and extent to which variations in student task-engagement corresponds with variations in students' achievement and attitude towards chemistry. It did not, however, seek to determine cause-effect relationship among the variables.

Sample and sampling techniques

The study population included the entire SS II science students of all secondary schools in Ibadan, Oyo State. 60 SSII chemistry students participated in the study. They were drawn from 10 randomly selected public secondary schools that offer chemistry at the SS II level. The chemistry students (6 per school) were selected by stratified random sampling; they all had average achievement scores in chemistry as ascertained via school records. In each school, the 6 chemistry students were from same class.

Instrumentation

Data were collected using a direct classroom observation instrument - the Student Task Engagement Record (STER) and 2 questionnaires - Chemistry Achievement Test (CAT) and Chemistry Attitude Questionnaire (CAQ) developed by the researcher. Science education experts provided face validation of the instrument, reordering and rephrasing questions as appropriate. The test blueprint below (Appendix II) ensured content validity of the CAT.

The Student Task Engagement Record (STER) is a two-point scale for recording student overt task-engagement (appendix 1a). Each of the 6 selected students is observed in 20 second turns. STER classified students' behaviour as: 1 = engaged behaviour (on-task) and 0 = non-engaged (off-task). Evidence of engaged behaviour included students' activities of:

i. Physically attending; looking at the teacher or the chalkboard;
ii. Working at desk, that is, taking notes from the lecture or chalkboard; and
iii. Interaction with teacher or students; such as, asking questions, responding to questions, or commenting on the objective-related issues.

Any behaviour that was not classified as one of the above was judged to have been non-engaged or off-task. Inter-raters reliability coefficient of 0.65 was obtained for the instrument by comparing ratings from two independent concurrent observation of students' engagement during a chemistry lesson.

The Student Chemistry Achievement Test (CAT) is a 30-item multiple choice objective test (4 options) covering the topics: Acids, Bases, Salts and Carbon/Carbon Compounds. These topics, contained in the term's scheme of work, were covered by the teachers at the study period. Science Education experts subjected the test to face validation; while test blueprint (appendix III) ensured content validity. A test-retest reliability coefficient of 0.72 was obtained for the CAT. This was calculated by comparing two sets of scores by 25 students who took, at two weeks intervals, two versions of the same test with test items rearranged.

The Chemistry Attitude Questionnaire, CAQ (Appendix II) comprised a 30-item scale with 4-point loading ranging from strongly Agreed (SD) to strongly Disagreed (SD). It gave a Crombach alpha reliability coefficient of 0.68. The CAQ specification include statements on: 'Likeness for chemistry', 'Emotional climate of the chemistry classroom', 'Chemistry curriculum', 'Chemistry teacher', 'Physical environment of the chemistry classroom/laboratory', 'Friends' attitude towards chemistry', 'Achievement motivation', 'anxiety', and 'Chemistry self-concept' (appendix II). Experts in science education provided face validation for it.

Procedure for data collection and analysis

Permission to conduct the study in the schools was sort for and obtained from school principals/heads. The researcher visited the schools and observed classroom lessons in chemistry -Acid, Base, Salt, and Carbon/Carbon Compounds. These lessons were already in the SSII chemistry curriculum/scheme of work for the term. Participant observation was used. Only the researcher observed and scored the STER to ensured uniform scoring across the selected students and schools. At the outset of observation, the students made choice of their setting positions; however, they were requested to maintain their position for the rest of the observation period. Student locations were numbered to allow for stratified random selection of 6 students. The school record was consulted to ensure that the 6 selected students were representatives of the class in terms of aptitude/achievement.

The researcher, taking non-interrupting position within the classroom, observed the selected students in turns of 20 seconds to determine whether or not each student was engaged. Using criteria spelt out in the instrumentation, the engagement status was scored as 1 or 0. The observations lasted throughout the 45 min lesson period. The STER shows observation time interval of 2 minutes (that is, 20 seconds for each of the 6 students)

Table 1. Simple statistics for the 3 variables: STDTASK, ACHIVT and ATTITUDE.

Variable	N	Mean	Std Dev	Sum	Min	Max	Max Exp	½ Max
STDTASK	10	11.2600	1.0069	112.6	9.0000	12.6000	15	7.5
ACHIVT	10	12.1200	2.9491	121.2	5.3000	15.3000	30	15
ATTITUDE	10	90.9250	3.4378	909.3	83.3000	96.2500	120	60

Table 2. Correlation analysis for STDTASK and ACHIVT.

		STDTASK	ACHIVT
	Pearson Correlation	1.00000	0.74366
STDTASK	Sig. (2-tailed)		0.0273
	N	60	60
	Pearson Correlation	0.74366	1.00000
ACHIVT	Sig. (2-tailed)	0.0273	
	N	60	60

P < 0.05. STDTASK means student task engagement; ACHIVT means student achievement in chemistry

and break intervals of 2 minutes. The break allowed for scoring of the STER as well as observation of some teacher variables not reported in this study. Same topics were taught across the classes/schools observed, and the CAT and CAS were administered during the last week of the 4 to 6 weeks classroom observations. Each class was observed three times for the research (at least once each week).

The data from the continuously coded STER (Appendix I), the CAT and CAS were analyzed using Pearson's product moment correlation and simple descriptive statistics. Average scores for each of the ten schools were calculated and correlated. Specifically, the SPSS 15.0 for Windows Version was used for the analysis.

RESULTS

The research question is 'What is the nature and extent of students' task engagement in chemistry?' Table 1 shows simple statistics of the study variables including Task Engagement (STDTASK) for all 10 classes. Table 1 shows a STDTASK mean score of 11.26 (Std = 1.0069, Min = 9, Max = 12.6) for all 60 students, which is more than half the maximum expected value ($Max_e = 15$; each student was observed 15 times during a 45-min lesson period). This indicates an overall high task engagement. There is also a pattern of high task engagement within each of the 10-science classroom observed (Appendix 1b).

HO_1: There is no significant relationship between students' task engagement and their achievement in chemistry.

Table 2 shows the Pearson's correlation between student task engagement and achievement in Chemistry. Table 2 reveals a strong, positive and significant correlation between students' task engagement and achievement in chemistry ($r = 0.74$; $p < 0.05$). This suggests that increase in students' task engagement corresponds with increase in achievement in chemistry. The null hypothesis Ho_1 is, therefore, rejected.

HO_2: There is no significant relationship between student task engagement and students attitude toward chemistry.

Table 3 shows the Pearson's correlation between students' task engagement and attitude towards chemistry. Table 3 shows a weak negative, insignificant relationship ($r = -0.03$; $p < 0.05$) between students' task engagement and attitude toward chemistry. This near zero correlation suggests that task engagement and attitudes in chemistry are almost independent of each other. Therefore, the null hypothesis HO_2 is not rejected.

DISCUSSION/RECOMMENDATIONS

Students' science task engagement was found to have significant positive relationship with achievement in Chemistry. This finding agrees with Orji (2011) and Johnson and Butts (1983) assertion that learner variables, including their pursuit (efforts) or active participation positively influenced learning outcomes. On the contrary, no significant relationship was found between students' task and attitude towards chemistry suggesting that any trend between students' engagement and attitude was a chance occurrence.

Table 3. Correlation analysis for STDTASK and ATTITUDE.

		STDTASK	ATTITUDE
STDTASK	Pearson Correlation	1.00000	-0.02869
	Sig. (2-tailed)		0.8277
	N	60	60
ATTITUDE	Pearson Correlation	-0.02869	1.00000
	Sig. (2-tailed)	0.8277	
	N	60	60

$p < 0.05$

Conclusion

Promoting science and technology for national growth and global competitiveness has been the priority of nations. At the classroom level, educationists and researchers are now focusing on the contribution of students' variables to successful learning and doing of science. This study sought to ascertain the relationship between students' science task engagement and achievement and attitude toward chemistry. It found that students' engagement had positive significant relationship with achievement, but was insignificantly related with attitude. Thus, school science improvement projects should target preparing and motivating students' for active task engagement in science.

RECOMMENDATIONS

The study therefore makes the following recommendations:

1. In addition to exposure to subject contents, students should be taught "what it takes to be actively engaged in science lessons.
2. Science teachers should seek practical ways to foster students' engagement for academic excellence.
3. Pre-service and serving teachers should be trained on designing and conducting appropriate learning task that will physically, mentally and socially engage students.

REFERENCES

Adesoji FA, Ige TA, Iroegbu TO, Olagunju AM (2003). Innovations in science teaching for new millennium. O. Ayodele-Bamisaiye, I. A. Nwazuoke and A. Okediran (Eds) *Education this Millennium – Innovation in Theory and Practice.* Ibadan: Macmillan Publishers.

Akey TM (2006). School context, student attitudes and behavior, and academic achievement: *An exploratory analysis.* New York: MDRC. Retrieved from http://www.mdrc.org/publications/419/full.pdf

Appleton JJ, Christenson SL, Furlong MJ (2008). Student engagement with school: Critical conceptual and methodological issues of the construct. Psychol. Schools 45(5):369-386.

Appleton JJ, Christenson SL, Kim D, Reschly AL (2006). Measuring cognitive and psychological engagement: Validation of the Student Engagement Instrument. J. Sch. Psychol. 44(5):427-445.

Beasley W (1983). Teacher management behaviours and pupil task involvement during small group laboratory activities. J. Res. Sci. Teach. 20(8):713-719.

Cangelosi JS (2008). Classroom management strategies: *Gaining and maintaining students' cooperation [6th Edition]*. Hoboken, NJ: John Wiley & Sons.

Carini RM, Kuh GD, Klein SP (2006). Student engagement and student learning: Testing the linkages. *Res. In Higher Educ. 47*(1):1-32.

Chapman E (2003). Alternative Approaches to assessing student engagement rates. Pract. Assess. Res. Eval. 8(13). Retrieved from http://PAREonline.net/getvn.asp?v=8&n=13.

Cherry K (2013) Correlational studies: Psychological research with correlational studies. Retrieved from http://psychology.about.com/od/researchmethods/a/correlational.htm

Christenson SL, Reschly AL, Wylie C (2012). Handbook of research on student engagement. Retrieved from http://books.google.com.ng/books/about/Handbook_of_Research_on_Student _Engageme.html?id=7LSxRvDF-RgC&redir_esc=y

Herr N (2007). Theories and Perspectives in Science Education. Retrieved from http://www.csun.edu/science/ref/theory-research/theories-science-education.html

Mosadomi W (2010). NECO releases results. *The Vanguard.* Retrieved on 12/7/13from http://www.vanguardngr.com /2010/09/neco-releases-result/

Nigerian Tech (n.d.) NECO results 2012/2013 GCE/SSCE Exams Results. Retrieved on 12/07/13 from http://www.naijatechguide.com /2010/01/neco-ssce-examination-2010-registration.html

Oranu PC (2012). Student Engagement: Issues and Concerns for Nigerian Schools in Achieving Mellennium Development Goals. Int. J. Acad. Res. in Progressive Educ. and Dev. 1(1):256-259.

Orji NS (2006). Relationship among teacher classroom management behaviours, students' task engagement, and students' outcomes in chemistry (Unpublished master's thesis). University of Ibadan, Ibadan.

Orji NS (2011). The influence of adults' socio-psychological characteristics on their active participation in adult educational programme. Niger. J. Teach. Educ. Teach. 9(1):356-370.

Science Council (2013). What is Science? Retrieved from: http://www.sciencecouncil.org/definition

Smith KA, Sheppard SD, Johnson DW, Johnson RT (2005). Pedagogies of engagement: Classroom-based practices. J. Eng. Educ.pp.1-15. Retrievedfromhttp://www.ce.umn.edu/~smith/docs/Smith- Pedagogies_of_Engagement.pdf

Taylor L, Parsons J (2011). Improving student engagement. Curr. Issues in Educ. 14(1):1-33.

APPENDIX I

A: Student's Task-Engagement Record (STER)

Time (min) / Student no	2-3	5-6	8-9	11-12	14-15	17-18	20-21	23-24	26-27	29-30	32-33	35-36	38-39	41-42	44-45	Total
1																
2																
3																
4																
5																
6																
Total																

*Key: 1 = on-task/engaged; 0 = off-task/disengaged

B: Class average scores for: STDTASK, ACHIVT and ATTITUDE

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
AVE STDTASK	11	11	12	11	13	12	11	12	9	12
AVE ACHIVT	15	14	13	13	12	9	12	12	5	16
AVE ATTITUDE	90.7	94.8	94.8	89.5	9.5	90.2	91	96.3	91.7	83.3

C: Test blueprint for the 30-item chemistry test

	Item numbers: 1-30					
	Knowledge	**Application**	**Analysis**	**Synthesis**	**Evaluation**	**Total**
Acids	1, 2, 4	3, 5	0	8	6, 7	8
Bases	9, 12	14, 15	13	11	10	7
Salts	16, 17, 20	18	0	18	0	5
Carbon	21, 23	24, 25	22	0	0	5
Carbon compounds	26, 27	28	30	0	29	5
TOTAL	12	8	3	3	4	30

APPENDIX II

Chemistry attitude questionnaire (CAQ)

Instruction: The statements in this questionnaire seek to find out how you feel about chemistry. Please tick in the appropriate column to show your feelings toward the statements. SA = Strongly Agree; A = Agree; D = Disagree; SD = Strongly Disagree. There is no right or wrong answers.

Name of student: ______________________ Sex: _________ Class: __________

S/N	Chemistry attitude statements	SA	A	D	SD
1.	Chemistry is a fun				
2.	I have good feelings towards chemistry				
3.	I like chemistry				
4.	I would enjoy being a chemist or chemical scientist				
5.	Everyone should learn chemistry				
6.	I feel nervous in chemistry class				
7.	I usually look forward to my chemistry class				
8.	We do a lot fun activities in chemistry class				
9.	We learn about important things in chemistry class				
10.	We cover interesting topics in chemistry class				
11.	I love spending my free time studying chemistry				
12.	I consider our chemistry classroom attractive and comfortable				
13.	Our chemistry classroom/laboratory contains a lot of interesting equipment				
14.	My chemistry teacher encourages me to learn more chemistry				
15.	I enjoy talking to my chemistry teacher after class				
16.	My chemistry teacher makes good plans for us				
17.	Sometimes my chemistry teacher makes me feel dumb				
18.	My chemistry teacher expects me to make good grades				
19.	My best friends like chemistry				
20.	Most of my friends do well in chemistry				
21.	I always try hard, no matter how difficult the work				
22.	When I fail that makes me try that much harder				
23.	I always try to do my best in school				
24.	I try hard to do well in chemistry				
25.	Chemistry makes me feel as though I am lost in a bush				
26.	Chemistry tests make me afraid				
27.	I would probably not do well in sciences if I took it in college.				
28.	I consider myself a good chemistry student				
29.	I think I am capable of becoming an engineer, scientist, chemist or doctor				
30.	In chemistry class, I feel being in control of my learning				