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# Attitude and Performance: A Universal Co-Relation, Example from a Chemistry Classroom*

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## ABSTRACT

Twenty-first century chemistry education researchers reported challenges in chemistry education pertaining to high school chemistry teaching-learning outcomes. Even though all studies intended to improve chemistry teaching-learning outcomes, unfortunately the impact of chemistry education research found not to be much encouraging. A few of these studies were compared to identify a possible missing link which is to be addressed under present context of chemistry education research (CER). The issue of students' attitude, perception and a link of performance in chemistry with attitude and perception drew the attention and found to be missing in the present CER studies. The need to address the issue within the context of existing school environment was felt. This communication is prepared based on an analysis of students' performance of eleventh grade students from a rural school of South Africa in a chemistry end-of- year test.

**Key words**: Chemistry teaching-learning outcomes, students' attitude, perception and performance.

## INTRODUCTION

Poor performance is a matter of concern and received attention of chemistry education research (CER) community for long. A critical observation indicates majority of CER directed at the need of methodology improvement for better chemistry teaching-learning outcomes. A dedicated observation of leading studies in chemistry education was made and reported here. After going through different CER literatures from 2002 -2016, fifty papers are summarized, which are chemical bonding and its related topics (Barker, 2000; Harrison and Treagust, 2000; Coll and Taylor, 2001; Coll and Treagust, 2001; Nicoll, 2001; Niaz (a), 2001; Coll and Taylor, 2002; Teichert and Stacy, 2002; Coll and Treagust, 2003; Özmen, 2004; Frailich et al. 2009; Taber et al. 2012; Dhindsa and Treagust 2014; Vladušić et al. 2016; Nimmermark et al. 2016),

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chemical equilibrium and misconceptions (Huddle et al. 2000; Voska and Heikkinen, 2000;chemical equilibrium and misconceptions (Huddle et al. 2000; Voska and Heikkinen, 2000; Niaz (b), 2001; Raviolo, 2001; Chiu et al. 2002; Kousathana and Tsparlis 2002; Van Driel, 2002; Harrison and Jong, 2005; Piquette and Heikkinen, 2005; Bartholow, 2006; Cakmakci et al. 2006; Aydeniz and Dogan, 2016; Ilhan et al. 2016), contents of solutions (Sanger, 2000; Pinarbaşi and Canpolat, 2003; Çalik, 2005; Çalik et al. 2005; Pinarbaşi et al. 2006; Çalik et al. 2007) and chemical reaction (Boo and Watson, 2001; Özmen and Ayas, 2003).

A review of CER literature focusing on chemical equilibrium was compiled by Bain and Towns (2016). Students' misconceptions in Radioactive chemistry (Parther and Harrington, 2001; Usta and Ayas, 2010), understanding about particulate nature of matter (Valanides, 2000; Özmen et al. 2002; Otham et al. 2008), problem of understanding on acids and bases (Sisovic and Bejovic, 2000; Varelas et al. 2006; Ouertatani et al. 2007) and students' conceptions in evaporation and condensation (Tytler, 2000) were also reported in CER literature. Students' understanding in qualitative analysis (Tan et al. 2002), issues of developing ionic concepts amongst the students (Waldrip and Prain 2012), learning of chemical formula (Taskin and Bernholt, 2012), shape and size of atom (Cokelez, 2012) are few more CER literature that drew attention in this study.

Efforts of all these studies were mostly to identify students' understanding and levels of misconceptions in respective chemistry contents for improvement in chemistry teaching-learning outcomes. Trends that were found embedded in various studies of CER are summarized in this discussion.

1. Most dominating of them were to identify and assess students' understanding or misconceptions in specific content areas discussed thereof, e.g. solubility equilibrium (Raviolo, 2001), solution chemistry (Çalik et al. 2005), nuclear chemistry (Usta and Ayas, 2010).
2. Others attempted to identify prospective teachers' and graduate students' level of understanding in different topics. For example; particulate nature of matter (Valanides, 2000), ionic bonding (Coll and Treagust, 2003).
3. Researchers also implicated inherited style of teaching methods as responsible for developing alternate concepts in chemical contents. Common sense chemistry as indicated to be a heuristic thought process of teaching chemistry is responsible for developing alternate concepts (Talanquer, 2006). It is also understood that students' misconceptions are caused by explanatory vacuum (Taber and Adbo, 2013).
4. Empowering the classroom teachers with suitable models to improve teaching-learning outcomes was also stressed by CER studies. Use of an interactive website to learn chemical bonding (Frailich et al. 2009), analogical model of teaching chemical equilibrium (Harrison and Jong, 2005), constructivist –based teaching model to teach dissolution of gasses in liquids (Çalik et al. 2007) are quite worth to mention here. Also, simulations and teaching chemical equilibrium (Huddle et al. 2000), cooperative learning method to teach acids and bases (Sisovic and Bojovic, 2000), student explanation and integration of ideas to promote understanding in chemical bonding (Teichert and Stacy, 2002), jigsaw technique of (cooperative) learning to teach chemical equilibrium (Doymus, 2008), effect of context based teaching structure on chemical equilibrium (Ilham et al. 2016) were found to attract interest of CER community.
5. Complexity of subject being responsible for poor performance has also been indicated in CER literature (Tyson et al. 1999). Chemistry being a difficult subject and hence responsible for students' poor performance (Xu and Clarke, 2012).

It is to be noted, studies mentioned mostly focused on teachers' activities around the content and pedagogy. These studies did not necessarily address the role that students need to play in classrooms in order to improve their learning outcomes of chemistry. There was almost negligible attention to the attitude or learning processes of students towards better learning outcomes in chemistry. A CER study also complained about research studies not being able to make an impact on classroom practices of teaching chemistry (Herrington and Daubenmire, 2016). A gap; regarding role of students influencing chemistry teaching-learning outcomes, was found in CER literature. Even though attitude in assessing basketball skill by students has been reported in literature (Vernadakis et. al. 2008), understanding of students' intention has its own implication over science learning (Martin-Gamez, Prieto-Ruz, and Jimenez-Lopez, 2016). It is also established that there, some relations between leisure attitude and students' persuasion for an undergraduate science course exists (Jdaitawi et. al. 2020). Another study while implementing a specific method of teaching-learning activity indicated a positive correlation between students' performance and their attitude towards school environment (Yildiz, Şimşek, and Ağdaş, 2018). In another study it is observed that high school curricula have their impact on students' attitude and further choice of science subjects at undergraduate courses (Al-Wahaibi et. al. 2019). In this study researchers are interested in finding the interrelationship (if any) between attitude and performance in a specific science subject.
This paper will make its contribution towards;

- The students' role required for better chemistry teaching-learning outcomes.
- Assisting the classroom teachers to understand the need to manipulate students' attitude towards better chemistry teaching-learning outcomes.
- Indicating relationship between improved student performance and their individual activities in a chemistry classroom.

It is understandable; for a vast rural country side of developing world, converting all classrooms into ideal, smart, technology empowered and student centric environments is an impractical proposition. Moreover, a classroom teacher bears no control on school and classroom environment in terms of amenities available to carry out a chemistry lesson, such as space and time for lesson delivery, or number of students to be accommodated in a classroom. Lack of practical works (Edomwonyi-otu, and Abraham, 2011), technological assistance for teaching-learning activities (Chowdhury, 2014) are reported missing from schools in CER studies. This could be mainly due to the scarcity of resources in schools. This study emphasized a need of pondering over the use of active manipulation of students' attitude to make an impact on chemistry teaching-learning outcomes. Instead of passively motivating students using different pedagogical models, students could be actively engaged to learn about learning techniques to learn better. There is a need of preaching 'how to learn' rather than 'what to learn' for performing better in a classroom situation. In fact, classroom teachers need to use double pronged method in their classrooms. They need to teach both chemistry and how to learn chemistry to the students. Chowdhury (2014); Bartolini Bussi et al. (2012); Moll (2003); Daniels (2001) considered learning as a dialectic process. These implicated students to play a pro-active role in improving their learning outcomes in chemistry. This discussion is an attempt to understand students' learning behavior in light of their performance in a chemistry test. Authors hope that this will motivate a classroom chemistry teacher to involve students in an appropriate discourse.

A long and in-depth study on students' perceptions and attitude on their learning environments had been reported by Wong et al. (1997). Wong et al. (1997) established a positive relation between students' perception about learning environment and attitude. It is claimed that a positive perception results in better chemistry teaching learning outcomes (Wong et al. 1997). Another observation proposed, 'learning outcomes is hugely influenced by students' perception' (Trigwell and Prosser, 1991). A recent study indicated that students' interest plays an important role in better teaching-learning outcomes (Margeti and Mavrikis, 2015).

Interest in chemistry may develop only when one has a positive perception about the subject. Chemistry teaching-learning outcomes not only depend on the pedagogy involved in teaching chemistry but also in the "Students' Approaches to Learning" (SAL) (Dolmans et al. 2015). Academic achievement is positively associated with the students' perception about their learning environment (Al-Qahatani, 2015). A positive perception leads towards deep learning and deep learning ultimately reflects in the enhanced performance of students. Deep learning is a product of students' interest in the subject (Entwistle, 1997; in Margeti and Mavrikis, 2015). Surface learning is a process where students complete a task with minimal engagement (Margeti and Mavrikis, 2015). This tendency of minimal engagement arises due to the fear of failure and a feeling of being threatened by the atmosphere (Margeti and Mavrikis, 2015). Existence of fear is mainly due to the lack of active engagement in teaching-learning process. Another factor that encourages the students towards superficial learning is to adopt a shortcut of learning instead of burning the late night fuel.

This study aims to draw a logical conclusion about students' performance and to draw a reason for some students' poor performance in an existing classroom condition.

In order to gain an insight of students' performance, the study proposed its research question as "why do some students perform better compared to other students under the same existing barriers that prevail in a given school setting?"

## METHODS

This study used a mixed method where both the quantitative and qualitative data were used for drawing a logical conclusion about the observations made in the study. This study assumed that performances of students of any selected classroom at higher grade will be similar with the attitude of students of lower grades in a same school because attitude will decide the nature of learning as surface or deep learning, so the performances will be poorer or better at higher grade due to the cascading effect of learning style. There were two distinct phases of data collection. In phase one of qualitative data collection; a questionnaire was used to extract information about students' perception on school environment. 20 grade nine and 20 grade ten students were randomly selected for collecting students' perception about school environment. In its second phase quantitative data regarding students' performance in chemistry was collected from 40 grade eleven students of the same school. In order to collect quantitative data, a department of basic education (DBE) controlled test (examination) performance record was collected from the sampled students'. The quantitative data collection tool (Examination Paper) was prepared by the provincial department of education and hence considered to be a valid and reliable testing tool for the study purposes. This question paper had ten questions and was divided as follows:

Question 1 covered all grade 11 Chemistry contents from topics related to Bonding and properties, Gas laws, Stoichiometry, Exothermic and Endothermic reactions, Redox Reactions and Metallurgy (covering entire course of the year);

Questions 2 and 3 covered the contents related to Bonding and related properties.

Question 4 covered contents related to Gas laws.

Questions 5 and 6 included Stoichiometry including a question on Empirical Formula.

Question 7 was based on Exothermic and Endothermic Reactions.

Questions 8 and 9 included Acid Base and Redox reactions.

Question 10 covered topics related to Metallurgy.

The test was administered by the school at end-of-year. The end-of-year scores in chemistry examination of grade eleven students from a conveniently selected school was collected for the

purpose of this study (November 2015). The school selected for this study was from a rural area of Nkomazi Municipality under Mpumalanga province of South Africa which had no library or functional laboratory and a large classroom. Selected classroom (sample) size was 40. Teacher used traditional (Kazeni & Onwu, 2013) and lecture note method (Ong & Ruthven, 2010) of teaching as classroom practices. Overhead projector was used to present old question papers and their answers to students. Students were provided with sample question papers and the answers of those questions. Students were depending on rote learning (Reddy, 2006) of contents of chemistry. There was no inter-learner or student-teacher discourse in classroom teaching-learning process of chemistry. Interview with students indicated most of the students had no stress about their learning and they were mostly relaxed about their learning process.
Achievement in any course including chemistry at high school level is tested on three grounds. Knowledge of the given contents, understanding of the said contents and application of contents. It is indicated that students' perception about chemistry classroom determines students' learning style (Trigwell and Prosser, 1991). A positive perception leads to deep learning and a negative perception leads to a superficial (surface) learning (Trigwell and Prosser, 1991). Superficial (surface) learning has a negative impact over understanding and application of chemical concepts and hence causes poor performance in examinations. Hence it will be sufficient to say that performance of a student is indicative of student's attitude towards learning environment.

Individual score of each of the forty students were collected and recorded anonymously for the purpose of this study. Performances of the students presented in table 1. Aim of this data analysis is to identify students' performance as a result of deep learning or superficial learning.

**Table 1.** *Score for all 40 students in all ten questions from question number 1 to question number 10 (X means not answered)*

| SL. No. | Q1/20 | Q2/17 | Q3/15 | Q4/19 | Q5/16 | Q6/21 | Q7/8 | Q8/12 | Q9/14 | Q10/8 | Total 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 3 | 7 | 6 | 0 | 0 | 2 | 3 | 2 | 1 | 28 |
| 2 | 4 | 5 | 4 | 4 | 1 | 0 | 0 | 0 | 0 | 1 | 19 |
| 3 | 6 | 6 | 2 | 4 | 0 | 0 | 2 | 0 | 1 | X | 21 |
| 4 | 2 | 5 | 2 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 13 |
| 5 | 6 | 2 | 5 | 5 | 3 | 1 | 3 | 3 | 0 | 3 | 31 |
| 6 | 8 | 9 | 4 | 7 | 3 | 3 | 5 | 2 | 4 | 0 | 45 |
| 7 | 10 | 3 | 4 | 4 | 6 | 0 | 1 | 1 | 0 | 0 | 29 |
| 8 | 6 | 3 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 1 | 16 |
| 9 | 8 | 3 | 4 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 17 |
| 10 | 8 | 2 | 4 | 2 | 3 | 0 | 3 | 0 | 2 | 1 | 25 |
| 11 | 12 | 3 | 0 | 4 | 2 | 0 | 2 | 2 | 1 | 1 | 27 |
| 12 | 6 | 6 | 1 | 2 | 0 | 1 | 3 | 0 | 0 | 2 | 21 |
| 13 | 6 | 1 | 1 | 2 | 3 | 0 | 0 | 0 | X | X | 13 |
| 14 | 6 | 4 | 6 | 2 | 0 | 0 | 1 | 3 | 1 | X | 23 |
| 15 | 2 | 5 | 2 | 6 | 0 | X | 3 | 0 | 2 | 1 | 21 |
| 16 | 8 | 3 | 5 | 4 | 0 | 0 | 2 | 2 | 0 | X | 24 |
| 17 | 4 | 2 | 1 | 1 | 0 | 2 | 2 | 1 | 3 | 1 | 17 |
| 18 | 16 | 13 | 4 | 12 | 5 | 0 | 5 | 5 | 4 | 1 | 65 |
| 19 | 4 | 0 | 1 | 0 | 0 | 3 | 1 | 0 | 1 | 3 | 13 |
| 20 | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 11 |
| 21 | 2 | 2 | 2 | 3 | 0 | 0 | 2 | 1 | 0 | 2 | 14 |
| 22 | 2 | 2 | 3 | 0 | 0 | 0 | 1 | 2 | 2 | 0 | 12 |
| 23 | 6 | 3 | 1 | 7 | 1 | 0 | 3 | 2 | 1 | 0 | 24 |
| 24 | 6 | 5 | 5 | 1 | 6 | 0 | 2 | 0 | 0 | 0 | 25 |
| 25 | 12 | 3 | 2 | 1 | 0 | 3 | 5 | 2 | 2 | 1 | 31 |
| 26 | 4 | 4 | 2 | 3 | 5 | 0 | 2 | 4 | 1 | 1 | 26 |
| 27 | 6 | 2 | 4 | 3 | 0 | 0 | 1 | 0 | 0 | 1 | 17 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 8 | 0 | 5 | 2 | 0 | 0 | 3 | 2 | 0 | 2 | 22 |
| 29 | 6 | 0 | 6 | 4 | 0 | 0 | 2 | 3 | 0 | 1 | 22 |
| 30 | 8 | 9 | 3 | 7 | 4 | 6 | 1 | 2 | 2 | 3 | 45 |
| 31 | 12 | 8 | 3 | 4 | 4 | 5 | 2 | 2 | 2 | 7 | 49 |
| 32 | 10 | 13 | 2 | 8 | 5 | 6 | 4 | 2 | 2 | 6 | 58 |
| 33 | 10 | 5 | 2 | 1 | 0 | 3 | 3 | 3 | 2 | 0 | 29 |
| 34 | 8 | 4 | 6 | 4 | 0 | 0 | 2 | 0 | 0 | 1 | 25 |
| 35 | 6 | 8 | 2 | 1 | 2 | 0 | 3 | 1 | 0 | 0 | 23 |
| 36 | 10 | 15 | 6 | 5 | 9 | 9 | 3 | 6 | 2 | 7 | 72 |
| 37 | 10 | 5 | 3 | 4 | 2 | 0 | 0 | 0 | 2 | 1 | 27 |
| 38 | 4 | 0 | 0 | 5 | 0 | 0 | 1 | 1 | 0 | 0 | 11 |
| 39 | 4 | 0 | 1 | 4 | 0 | 1 | 1 | 1 | 2 | 0 | 14 |
| 40 | 10 | 7 | 12 | 4 | 3 | 9 | 2 | 7 | 1 | 3 | 58 |

As indicated earlier poor performance correlates surface learning. Four students' (Students numbered 30, 31, 32 and 40) indicated the sign of lesser surface learning. These students didn't score a zero in any question. All remaining 36 students exhibited the sign of surface learning overwhelmingly. These 36 students scored a zero in varying orders.

The question paper under discussion had ten questions. Question number one was an objective type question containing ten separate questions embedded in it. Students were asked to find the correct answer from a given set of five answers provided at the end of each question.

Questions number two till question number ten were short, content-based questions. Question-wise performance of students is tabulated in Table 2 to indicate number of students scoring a zero, 30%, 40%, and 50% plus and more than a zero but less than 30% in the observed test (Table 2).

**Table 2.** *Question-wise score of students*

| Q No. | Score % | No. of St. | % of St. | Q No. | Score % | No. of St. | % of St. |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 6 | 0 | 26 | 65 |
| | 1 to 29 | 8 | 20 | | 1 to 29 | 10 | 25 |
| | 30 to 39 | 15 | 38 | | 30 to 39 | 2 | 5 |
| | 40 to 49 | 7 | 18 | | 40 to 49 | 2 | 5 |
| | 50 up | 10 | 25 | | 50 up | | |
| 2 | 0 | 6 | 15 | 7 | 0 | 5 | 13 |
| | 1 to 29 | 18 | 45 | | 1 to 29 | 12 | 30 |
| | 30 to 39 | 8 | 20 | | 30 to 39 | 10 | 25 |
| | 40 to 49 | 3 | 8 | | 40 to 49 | 9 | 23 |
| | 50 up | 5 | 13 | | 50 up | 4 | 10 |
| 3 | 0 | 2 | 5 | 8 | 0 | 13 | 33 |
| | 1 to 29 | 28 | 70 | | 1 to 29 | 24 | 72 |
| | 30 to 39 | 4 | 10 | | 30 to 39 | | |
| | 40 to 49 | 5 | 13 | | 40 to 49 | 1 | 3 |
| | 50 up | 1 | 3 | | 50 up | 2 | 5 |
| 4 | 0 | 5 | 13 | 9 | 0 | 15 | 38 |
| | 1 to 29 | 28 | 70 | | 1 to 29 | 23 | 58 |
| | 30 to 39 | 5 | 13 | | 30 to 39 | 2 | 5 |
| | 40 to 49 | 1 | 3 | | 40 to 49 | | |
| | 50 up | 1 | 3 | | 50 up | | |
| 5 | 0 | 21 | 53 | 10 | 0 | 12 | 30 |

| | | | | | |
|---|---|---|---|---|---|
| 1 to 29 | 13 | 39 | 1 to 29 | 19 | 49 |
| 30 to 39 | 3 | 8 | 30 to 39 | 2 | 5 |
| 40 to 49 | 2 | 5 | 40 to 49 | 4 | 10 |
| 50 up | 1 | 3 | 50 up | 3 | 8 |

81% of students passed in question number one. None of the students scored zero in this question. Question number one was a multiple choice type question having ten questions in total. All ten questions in question number one were designed to cover the complete course taught to the learners during the whole academic year. All questions were either understanding or application-based questions. Performance in question one represents a fair view of students learning outcomes in chemistry. Students seemed to know the facts and factors regarding the contents they had been taught. Otherwise it was not possible for them to perform this well in application and understanding-based questions. Same positive image is shattered as soon as performances of students in other questions is exposed. There are students who scored zero in every question from two to ten. In one of the questions (Q6) 65% of students scored zero. The failure rate is more than 75% in most of the questions. This is almost the opposite of performance of question number one. This indicates students' failure to analyze information and facts they learned in different contents taught to them. Every question from question two to ten consisted of three main parts, knowledge part, and higher level understanding & application part. Getting a lower score in these questions exhibit students' poor understanding of the subject contents.

Table three displays percentage of students scoring less than 30% score in a question along with percentage of students scoring 0 in the same question. It is proposed if a student scores zero in a question, then no learning has taken place and if a student is scoring more than zero but less than 30% then the learning is superficial, which indicates the presence of surface learning.

**Table3.** *Percentage of students scoring "0" and "between 0 and 30%"*

| Question No. | Percentage of students' scoring "0" | Percentage of Students' scoring "between 0 and 29%" |
|---|---|---|
| 1 | 0 | 20 |
| 2 | 15 | 45 |
| 3 | 5 | 70 |
| 4 | 13 | 70 |
| 5 | 53 | 33 |
| 6 | 65 | 25 |
| 7 | 13 | 30 |
| 8 | 33 | 60 |
| 9 | 38 | 58 |
| 10 | 30 | 48 |

As in Table 3, an average of 27% students found to have scored zero and 46% of students scored more than zero but failed to perform over 30%. This trend of performance strongly indicates that students' learning is surface learning and not deep learning.

Another set of data were generated from two groups comprising twenty students in each group, from the same school studying at grade nine and ten. The data were then compiled together to assess students' attitude towards their learning environment in the sampled school.

A yes and no response type of questionnaire was used for this purpose. The questionnaire used is presented in Table 4.

**Table 4.** *Questionnaire to study students' attitude*

| | | Yes | No |
|---|---|---|---|
| 1 | I feel the school belongs to me. | | |
| 2 | I feel comfortable at school. | | |
| 3 | I think while doing my home or class work. | | |
| 4 | I have freedom at school. | | |
| 5 | Studying is difficult. | | |
| 6 | I copy my work from my friends. | | |
| 7 | I enjoy my study. | | |
| 8 | My teachers care about me. | | |
| 9 | I love my school. | | |
| 10 | I get stressed when doing my work. | | |

Following observations were made from the analysis of the students' responses in the questionnaire.

*i) None of the student considered school as their own.*
*ii) Only 2% of the students felt comfortable at school.*
*iii) None of the students felt that they had freedom at school.*
*iv) 15% of the students agreed to love their school.*
*v) 40% of the students appreciated that teachers' care about students.*
*vi) Studying was difficult for 100 % of them.*
*vii) 90% of them agreed that they copy their work from their friends.*
*viii) Only 5% of the students said that they enjoy their study.*
*ix) Only 10% agreed to have study related stress.*
*x) All students reported that they never think while answering a question.*

Most students along the spectrum had a negative perception of their school environment. This implicates that students are moving upwards in the classroom hierarchy with the existing negative attitude and perceptions which probably acts as a stumbling block towards a better teaching-learning outcomes in chemistry education.

## FINDINGS and DISCUSSION

Lack of learning was evident from analysis of students' test performance. It is observed only four student could score in all the 10 test items. It is suggested, when students adopt a surface approach to learning, they learn to respond by keywords using their memory but fail to answer a new set of questions where the use of keywords and ideas is required and face difficulty to answer posed question (Hubbard, 1997). Surface learning does not allow a student to gain a higher level understanding of chemistry contents and is a result of negative perception about school environment (Entwistle, 1997; in Margeti and Mavrikis, 2015). Out of 40 students 36 of them scored a zero in at least one content areas of their course.

**Table 5.** *Presenting number of students scoring zero in number of questions*

| No. of Students | No. of Zero Score |
|---|---|
| 4 | 0 |
| 6 | 1 |
| 7 | 2 |
| 10 | 3 |
| 8 | 4 |

| | |
|---|---|
| 2 | 5 |
| 1 | 6 |
| 1 | 7 |

From table 5 it is clear that most of the students underwent superficial or surface learning. It will not be improper to say that, there was negative attitude towards learning environment which had caused surface learning as evidenced from poor performance of students (Awang et. al. 2013). Another indication of surface learning is observed in the performances on question number one. While practicing on old question papers students answered many objective-type questions and many of those questions were practiced repeatedly. This helped some students recall and write the answer without any mental exercise. Also guess work in answering question one which could lead to a correct response. As a result, no student scored zero in question one. Performance on question number one does not represent the reality of students learning. Rather, students' performance is well explained by their performances in questions 2-10. Range of scoring zero varied from 5% in question number three to 65% in question number six. Question number three was dominated by knowledge based questions and students could recall and answer partially and scored some marks in the question. Unfortunately the percentage of those who passed in the same question was only 25%. Few of the questions could have been answered by simple recall basis and suggests dominance of surface learning. We know; learning and performance is affected by students' attitude towards learning environment (Mazana, Montero and Casmir, 2019). Hence surface learning should be a reflection of students' attitude and perception about learning environment. If this argument stands, the next step is to verify whether the attitude straits of students from the same school also indicate the presence of negative perceptions about school environment.

Analysis of questionnaire found that students' response impulsively in examination, instead of taking a thoughtful action in writing a question answer. 90% of the students agreed not to have any study related stress. 90% of the learners reported to have copied their work from their peers. 100% of students expressed studying as a difficult task. 100% of students felt uncomfortable and less freedom in school. Considering students' responses about their perception on the same school, it is observed that they were growing with recurring negative attitude about their school environment. This negative attitude and perception is one of the most important factors behind every underperforming student. Surface learning is one of the most avoidable monsters mostly in rural schools that requires to be eliminated by a regular directed discourse with the students. A chemistry subject teacher needs not only to teach the subject but also needs to teach the students how to make their learning effective. There exists a need to help students to grow with a positive perception about their school atmosphere and not to feel threatened. Observations made correspond with the nature of poor performance with negative perceptions of students. This raises the question of reverse reliability. Does the better performance correspond with the positive attitude exhibited by the two group of students? From the examination performance it is observed that 13% of students never scored zero in any of the question. There is something special in these 13% students that distinguished them from the others. This quality of them helped them to perform better than the rest of the population in spite of several barriers present in the school environment (Chowdhury, 2014). These students exhibited different straits in their performance style. They certainly underwent a sort of deep learning with a positive attitude towards their school environment. On a similar note, 15% of sample studied for their attitude exhibited a study related stress and loved the school environment.

## CONCLUSION

Although the study was carried out in a single school, it had the advantage of selecting two different samples in the same school. The better performance of 13% students in the examination for one sample of 40 students, and a positive perception of 15% of students for the other sample of 40 students exhibit a mirror image of each other. They were found to be so closely correlated that one might be forced to think that both data set were collected from the same sample group. Similarly, poor performance (87%) of students and a negative attitude (90%) also exhibit a close relationship. All these observations indicate a need of introducing investigations on how to eliminate surface learning by changing students' perception and attitude in CER studies. In conclusion, chemistry teachers need to forgo the lecture and note delivery method of teaching and adopt a suitable student-centered teaching method as suggested by numerous chemistry education researchers. Chemistry educators at high schools need to stress on the importance of deep learning over the surface learning and engage the students in a discourse process while teaching chemistry. Because a dialogic discourse always paves the way towards mental engagement and hence deep learning (Chowdhury, 2014; Chowdhury et al. 2018).

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