

# THE RELATIONSHIP BETWEEN CONCEPT PERCEPTION AND STUDENT ACHIEVEMENT IN THE SUBJECT AREA OF CHEMISTRY IN SCIENCE

Ven B.Siri Sumedha

Assistant Director of Education Ministry of Education, Sri Lanka

## **ABSTRACT:**

*Science education has undergone many reforms since the past to improve the learning and teaching process. Teachers' knowledge and motivation, and teachers' teaching techniques, determine how students understand science concepts. In the journey of taking students to innovations in education, the teacher who provides science education in the classroom has a great responsibility (Research and Development Branch, 2017). It is also necessary to identify the problems faced by students in building science education. The analysis of the examination department's results and evaluation reports shows that compared to other subjects, the minimum mark is obtained for the science subject. The Sri Lanka Examination Department's 2017 G.E.C. (G.E.) evaluation report also shows that among the three fields of science, biology, chemistry, and physics, the facility for the field of chemistry is low. For this reason, it was the main interest of this research to find out the correlation between student performance and conceptual understanding of students who learn the content of the chemistry subject of the science subject. For that purpose, the size of the sample was determined using the table of determination of the sample size presented by Krejcie & Morgan (1970) and the correlational study research strategy using 400 students of 08 secondary schools in the Kegalle district of Sri Lanka selected through a cluster random sampling method as the sample. The research was conducted using a quantitative design. For this, Katerina Salta & Chryssa Tzougraki (2004) used an aptitude test set according to the Likert scale and a structured type of achievement test set according to Bloom's classification to find out the level of concept perception of 11th grade students in a school in Greece. A control test was administered to 10% of the research instrument sample. By analyzing the data collected, the research instruments were standardized. Then by giving the research equipment to the main sample, the collected data was analyzed, and conclusions were drawn from the data interpretation. Here, a positive correlation of Pearson correlation coefficient ( $r = + 0.720$ ) was found between students' conceptual understanding and student achievement. It was recognized that appropriate student-centered methods should be used in the learning and teaching process as student achievement increases when students' conceptual understanding increases.*

## **KEYWORDS**

*Conceptual Perception, Student achievement, Chemistry, G.C.E (O/L) examination*

## **BACKGROUND AND SIGNIFICANCE OF THE RESEARCH**

Among the public examinations in Sri Lanka, the examination for which the largest number of applicants appear is the G.E.C. Students are selected for higher education based on the results of this examination held at the national level. In addition to this, the primary qualification for getting mid-level jobs is the G.E.C. The GCE is the base level of the 12-level Sri Lanka Qualification Framework (UGC, 2016) included in the Sri Lanka Eligibility Guidelines issued by the University Grants Commission.

It is seen that the students as well as the teachers and parents are working hard to get an elevated level of performance in this exam. Meanwhile, it is mandatory to appear for six main subjects and three category subjects related to this examination. The examination department points out that passing the six main subjects is mandatory. But out of that, the percentages of passing the three subjects of Science, Mathematics, and English are at an exceptionally low level.

However, out of these three subjects, students' interest in the science subject is overall very low. Despite the effort to pass the mathematics subject, the students' overall effort to pass the science subject is minimum. Some students are also tempted to give up the science subject.

At present, the student achievement in the science subject related to the senior secondary school curriculum is at a low level and the percentage of A and B passes relative to other subjects is also at a minimum level. Similarly, the number of people who fail English subject increases relative to all subjects, and after that, mathematics and science subjects are among the failed subjects. This is clear from the examination department's analysis of the results of the students who appeared for the first time in the 2018 G.E.C (O/L)

Table 1- Pattern of Passes in GCE (O.L) Examination (2018)

Subject	No of Candidates	A		B		C		S		W	
		No	%	No	%	No	%	No	%	No	%
Buddhism	211506	71206	33.67%	35660	16.86%	45579	21.55%	33257	15.72%	25804	12.20%
Sinhala	230015	46483	20.21%	49931	21.71%	80218	34.88%	33368	14.51%	20015	8.70%
English	295744	31769	10.74%	21713	7.34%	45027	15.22%	63857	21.59%	133378	45.10%
Mathematic	295406	47643	16.13%	27737	9.39%	65965	22.33%	60419	20.45%	93642	31.70%
History	295991	52118	17.61%	37097	12.53%	83287	28.14%	73699	24.90%	49790	16.82%
Science	295619	24380	8.25%	21682	7.33%	64759	21.91%	95620	32.35%	89178	30.17%

### ACCORDING TO THE ANALYSIS OF RESULTS 2018 OF EXAMINATION DEPARTMENT

In the science subject evaluation report released by the examination department in the year 2018, it is seen that the achievement levels related to the chemistry subject content from the fields of physics, chemistry and biology related to the science subject content are decreasing.

The evaluation report of the year 2017 presented by the Research and Development Branch of the

Sri Lanka Examinations Department indicates that the ease of the first paper of the science subject of the G.E.C(O/L)

Table No. 2.- Facility Percentage Values for Science Paper I Questions of GCE (O/L) Examination (2017)

Question NO	Subject Area	Convenience is biggest issue and its convenience	Convenience is the least of the issues and its convenience
1"3"5"7"9"13"15"21"23"25"26"27"32"34	Biology	13^78%)	32^44%)
2"8"10"17"18"19"27"30"33"35"36"37"38"39	Physics	27^69%)	36^24%)
4"6"11"12"14"16"20"22"24"28"29"31	Chemistry	20^53%)	29^29%)
40	General	40^59%)	-

According to the above table no. 2, among the three subject areas of science subject, the ease shown for the chemistry questions is the highest and low compared to the other two areas. Also, the chemistry question is the least convenient and its convenience is also exceptionally low, and only a slight increase is seen over physics.

In addition to this, by analyzing the results of the 2019 final term examination of a few randomly selected schools belonging to the Kegalle Education Zone in the Sabaragamuwa Province of Sri Lanka, it was also identified that the students scored less than 50% of the marks for the entire science subject- related to the subject content of Chemistry and Physics. It is also seen that due to the decrease in the level of marks obtained, students' interest in the questions related to the biology subject content which can be scored easily is also reduced.

Science is a systematic approach to acquiring and applying knowledge and understanding about the natural and social world (Council, 2009). In learning the subject of science, it is especially important to understand the concepts and identify the interrelationship between each concept (Ahmad Syakirin Johari, Anuar Ahmad, 2016). Likewise, further explaining the theory presented by Piaget (Vygotsky, 1978), it is pointed out that the science teacher should never think that the student is staying in the classroom as if he does not know anything. He is present in the classroom with prior knowledge based on various experiences gained since childhood. Here, the student's prior knowledge may contain false or immature concepts and developed concepts. To cross the ZPD (Zonal Proximal Development) zone by identifying them correctly, it has become the task of today's teacher to work as teacher.

To improve educational achievements, various strategies are used in the learning and teaching process to better understand important concepts (A.Rohman, 2014). But whether such strategies are currently being used in Sri Lanka should be investigated further- It would be timely to investigate whether students' ability to perceive chemistry concepts affects students' student achievement levels.

Also, although there has been a minimal amount of research on the decline in achievement in the entire science subject in Sri Lanka, there are almost no studies on the decline in grades related to

chemistry content in grades 10-11. Accordingly, this research is expected to provide some support to increase the achievement level of the entire science subject in the senior secondary school by increasing the chemistry achievement levels of the students through the identified factors.

## **INTRODUCTION TO THE PROBLEM**

Education is the only and main way to higher social mobility (Amutabi,2003). Numerous factors affect the performance of students. Most of the students studying science in senior secondary school show a tendency to fail in this subject. Apart from that, it has been shown in the evaluation report of the science subject presented by the examination department in 2017 that the number of marks obtained in relation to the chemistry subject content of the science subject is very low compared to other parts. Many science students say that chemistry is difficult to understand. Therefore, the problem is whether the students have a better understanding of chemistry concepts - and thus the research problem became to find out if there is a relationship between students' understanding of chemistry concepts and student achievement.

## **LITERATURE REVIEW**

"Concepts can also be defined as a classification of people, objects and phenomena in the environment. Forgetting the insignificant differences that may occur within a class of objects, considering only the key features between them, considering them to be in one class and calling them by a common name" (Abepala, Roland, 2010). Understanding the concepts in the classrooms will allow teachers to create effective learning opportunities, as well as improve learning and skills such as critical thinking and diversified thinking in the educational process, initiating creativity and collective responsibility (Baskaran, 2001). The use of appropriate new methods is very important to bring the concept proof to a higher level for creating (Aboagye,2009). Good conceptualization by the student also depends on the way the teacher teaches the lesson. It is also very important for the teacher to teach in such a way that the interrelation between the concepts is clear (Lkeobi, 2010).

Scientific concepts are mostly taught. It develops knowledge from the known to the unknown (Ogembo, 2012). Science is the adoption of systematic methods to obtain and apply knowledge and understanding of the natural and social world (Science Council, 2009). In learning the subject of science, it is particularly important to understand the concepts and recognize the interrelationship between each concept (Nweze, 2019). The act of realizing concepts by the individual is said to be an intellectual process (Bruner, 1964). Often a subject like science is a combination of many concepts - and much of the chemistry and physics content is built around concepts. Alfred Binay presented facts for the first time through a formal test that the intelligence of students is important for their educational achievement, and it has been discovered that other factors besides intelligence can influence the level of achievement (Wijesekara, 1977). Also, a student's ability to achieve student achievement is due to the influence of other factors in addition to intelligence: Ndayb (Johanna Turner, 1977).

Many researchers who are looking for the reasons for the poor achievement and performance of the science subject indicate that chemistry achievement is at a low level as a reason (A.Hassan, 2015). Also, the researchers further point out that although many schools are more interested in teaching the theoretical parts of chemistry, the interest in practical activities is low, which has a major impact

- according to research conducted in secondary schools in Zanzibar, Tanzania, this is due to lack of familiarity with the language and terminology used in chemistry. Many students are having trouble grasping or acquiring chemistry concepts. It is also said that most of the teachers do not have the ability to make students understand chemistry concepts correctly (A.Hassan, 2015). Considering the amount of research that has been done locally for science education achievement, there is almost no study on the factors affecting achievement related to chemistry content. Therefore, to increase student achievement related to chemistry content, it is necessary to find out to what extent students' conceptual understanding is affected.

## **RESEARCH METHODOLOGY**

A formal examination system is implemented in the school in accordance with a formal plan and syllabus. The educational level of the students is determined based on the results of those tests. Also, educational achievement has a special importance as an important indicator that measures its results in the educational process. The broad objective of this research was to conduct a study using a quantitative research design to measure the relationships between students' chemistry concept perceptions and student achievement.

After identifying the size of the sample, 302 students were selected from 8 schools of different types (1AB, 1 C, type 2, Senior Pirivena) from the four educational Divisional of Kegalle Education Zone, in Kegalle district of Sri Lanka under the cluster random sampling method.

Katerina Salta & Chryssa Tzougraki (2004) used a Likert scale questionnaire administered to students to assess their level of understanding of Greek 11th grade chemistry concepts, and chemistry using a distinctive table according to Bloom's taxonomy. A science question paper was also used. Revisions were made to protect the reliability and validity of the research instruments by means of a regulatory test (Pilot test). Reliability was measured by calculating Cronbach's alpha value. A factor analysis was done to measure the validity.

Accordingly, Cronbach's alpha value was 0.958 and significant value ( $p < 0.000$ ) and the research instrument had a high internal consistency. ( $F=48.186$ ;  $df= 23$ ;  $p < 0.000$ ) Standardized research instruments were given to the sample and in the analysis of the collected data, hypotheses related to the research questions were formed and one way ANOVA and Correlation regression were carried out through statistical methods. Here (Shnn Turney (2022) has shown that Pearson's and correlation coefficient can be used in such cases, so the Pearson ( $r$ ) correlation coefficient was calculated Abdul Rauf Ridzuan et., 2015). According to the information obtained from the data analysis, the data interpretation was done, and conclusions were drawn.

## **RESEARCH FINDINGS:**

What is the correlation between students' understanding of chemistry concepts and chemistry student achievement?

H<sub>0</sub> ; There is no relationship between students' chemistry concept perception and students' chemistry achievement.

H<sub>1</sub>; There is a relationship between students' chemistry concept perception and students' chemistry achievement.

In answering the above research question, the following findings were made.

Table 3. Correlation between conceptual understanding and student achievement

Correlations			
		CHEMISTRY STUDENT ACHIEVEMENT	STUDENT PERCEPTION
CHEMISTRY STUDENT ACHIEVEMENT	Pearson Correlation	1	.720
	Sig. (2-tailed)		.739
	N	399	24
STUDENT PERCEPTION	Pearson Correlation	.720	1
	Sig. (2-tailed)	.739	
	N	24	24

According to Table No. 3 above, the Pearson and correlation coefficient between students' chemistry concept perception and students' chemistry student achievement is seen as  $r = +0.720$ . ( $0.70 \leq r \leq 0.99$ ), there is a strong positive correlation.) Accordingly, it was seen that there is a strong positive correlation between students' conceptual understanding and student achievement in chemistry. That is, the null hypothesis ( $H_0$ ) is rejected, and ( $H_1$ ) is accepted. Here, as the independent variable increases, the dependent variable also increases strongly.

Table 4. Analysis of Variance between Conceptual Understanding and Student Achievement

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	48.646	1	48.646	.114	.000
	Residual	9429.187	22	428.599		
	Total	9477.833	23			

a. Dependent Variable: CHEMISTRY STUDENT ACHIEVEMENT  
b. Predictors: (Constant), STUDENT PERCEPTION

According to Table No. 04, the significant value is  $0.000 < 0.005$ , so the regression model is statistically normal. ( $f=.114$ ,  $df=1$ ,  $p=.000$ ) (Significant value should be  $< 0.05$ .)

Table 6. Measurement of R square value.

Model Summary <sup>b</sup>				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.072 <sup>a</sup>	.605	-.040	20.703

a. Predictors: (Constant), STUDENT PERCEPTION  
b. Dependent Variable: CHEMISTRY STUDENT ACHIEVEMENT

Table number 6 ( $R \text{ square} = .605$ ) showed that there is a 60.5% relationship with the literature review.

## CONCLUSIONS

- In conducting hypothesis tests related to data analysis, the null hypothesis (H<sub>0</sub>) has been rejected and the null hypothesis (H<sub>0</sub>) has been accepted.
- The research instrument was found to have 60.5 % correlation with the research literature.
- A positive correlation was found between concept perception and student achievement. That is, when the influence of the independent variable increases, the dependent variable also increases. That is, when the understanding of concepts increases, student achievement increases.
- Although most teachers recognize the value of student-centered teaching methods, these are often not used in the classroom.
- Although practice tests are important for concept recognition work, many teachers do not seem to conduct practice tests.
- In most teachers, the use of support that can provide concrete experiences in the learning and teaching process is minimal.
- Society's understanding of the use of chemistry in everyday life is minimal.
- tendency to confirm concepts through life experience is minimal.
- Students have a negative attitude towards chemistry as a subject with complex concepts that are difficult to understand.

## Proposals:

- It is important to choose the most appropriate learning and teaching style so that the students understand the concepts better.
- Introduction of psychological methods that can easily remember facts and concepts should be done.
- Teachers should always use a variety of aids to make abstract concepts easy to understand. Then the complexity in the students of the subject will be missed.
- Students should be made aware of environmental sustainability in the application of chemistry knowledge.
- In order to remove the reluctance of students in understanding concepts, learning styles should be changed in such a way that they can learn with pleasure.
- As shown by social constructivism, by giving students the opportunity to learn collectively, they will have the opportunity to learn satisfactorily.
- Use of laboratories should be increased. It will be very important that the laboratory equipment and materials required for this are at the optimal level. Friendly support of laboratory assistants should be provided to the students. Teachers should be encouraged and trained to plan lessons where labs are used whenever possible. In addition to this, activities should be planned in such a way as to minimize the wastage of chemicals.
- Student centric trends should be increased, and teachers should be updated for it. Activities should be planned in such a way that creative thinking develops in the students. It is mandatory to train teachers as needed.
- Teaching styles should be developed in relation to taking students from what is known to what is unknown by matching them with their normal life experiences.
- Work should be done to remove the negative attitudes of students regarding chemistry as a subject with complex concepts that are difficult to understand.

## REFERENCES

- [1] Ahn, J. (2002). Beyond Single Equation Regression Analysis: Path Analysis and Multi-Stage Regression Analysis. *American Journal of Pharmaceutical Education*, 66 (Spring), 37-42
- [2] Anzi, E., & Owayed, F. (2005). Academic Achievement and its Relationship with Anxiety,

- SelfEsteem, Optimism, and Pessimism in Kuwaiti Students. *Social Behavior and Personality* , 33 (1), 95-104.
- [3] APA, NCME, AERA. (1999). *Standards for Educational and Psychological Testing 1999*. Washington, DC: American Educational Research Association.
- [4] Ary, D., Jacobs, L. C., & Sorensen, C. (2006). *Introduction to Research in Education*. Belmont: Wadsworth.
- [5] Astebro, T. (1998). Basic statistics on the success rate and profit for independent inventors. *Enterpreunership, Theory and practice* , 23 (2), 41-48.
- [6] Babbie, E. R. (1990). *Survey Research Method (2nd Edition)*. California: Wadsworth Publishing.
- [7] Babbie, E. R. (2005). *The Basics of Social Research (Third Edition)*. Belmont: Wadsworth Publishing.
- [8] Barret, P. (2007). Structural equation modelling: Adjudging model fit. *Personality and Individual Differences* , 42, 815–824.
- [9] Barron, R. M., & Kenny, D. A. (1986). The mediator-Moderator variable distinction social psychological research; conceptual, strategic and statistical considerations. *Journal of personality and Social Psychology* , 51, 1172- 1183
- [10] Blunch, N. J. (2008). *Introduction to Structural Equation Modeling using SPSS and AMOS*. London: Sage.
- [11] Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. New Jersey: Lawrence Erlbaum Associates Inc.
- [12] Cohn, M. A., Fredrickson, B. L., Brown, S. L., Mikels, J. A., & Conway, A. M. (2009). Happiness Unpacked: Positive Emotions increase life satisfaction by Building Resilience. *Emotion* , 9 (3), 361-368.
- [13] Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of applied psychology* , 78 (1), 98-104.
- [14] Council, S. (2009). *Our definition of science*. Science Council: London.
- [15] Cronbatch, L. J. (1951). Coefficient alpha and the internal structure of tests. *Pstchometrica* , 16 (3), 297-334.
- [16] Csikszentmihalyi, M. (2009). The Promise of Positive Psychology. *Psychological Topics* , 18 (2), 203-211
- [17] Dattalo, P. (2009). Review of software for sample size determination. *Evaluation and the Health Professionals* , 32 (3), 229-248.
- [18] Dhaqane, M. K. (2016). Satisfaction of Students and Academic Performance in Benadir University: *Journal of Education and Practice*. Malaysia.
- [19] Diener, E., Emmons, R. A., Larsen, R. J., & Graiffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment* , 49 (1), 71-76.
- [20] Diener, R. B., & Diener, E. (2001). Making the best of Bad situations: Satisfaction in slums of Calcutta. *Social Indicators Research* , 55, 329-352.
- [21] *Education Perspectives : Research and Development Branch*, M. O. (2016). Ministry of Education: Baththaramulla.
- [22] *Education Perspectives : Research and Development Branch*, M. O. (2017). Ministry of Education: Baththaramulla.
- [23] *Education Perspectives : Research and Development Branch*, M. O. (2018). Ministry of Education: Baththaramulla.