



Green Chemistry- An Awareness Among 1 Degree Students of Bangalore City Colleges

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Abstract : Green Chemistry is the design of chemical products and process that reduce or Eliminate the use or generation of hazardous substances. Green Chemistry awareness is Highly essential for under graduate students as it is offering concrete solution to many of The challenges that the society is facing. Green chemistry is also called sustainable chemistry.Green chemistry innovations are happening across the Globe in both Universities & Institutions.In the present study the awareness of Green Chemistry was investigated among first year Degree science students of Bangalore city. Some Good colleges were selected under fiveCategories. The awareness was monitored through a Questionnaire .The results were statically Analyzed by Chi square method and two Hypotheses were tested.

Key Words: Green Chemistry; Pollution Remediation; Environmental Education; Sustainability; Environmental Protection Agency.

Introduction:

Green chemistry is commonly presented as a set of twelve Principles (1-3) proposed by Anastas (Father of Green chemistry) and Werner. Green chemistry Incorporates a new approach to the system, processing and application of chemical substances in such a manner as to reduce threat to health and environment.Scientist and researchers are mainly concentrating on avoiding environmentally Non-compatible reagents. Chemist from all over the World are using their creative and innovative Skills to develop new process, synthetic methods, reaction conditions, catalyst, etc; under the New Green chemistry Concepts (4).To name one of them is an efficient Bio catalytic process to Manufacture Simvastatin.It is leading drug for treating high cholesterol is manufactured from a natural product. The traditional multi step synthesis was wasteful and used large amounts of hazardous reagents. Professor Yi Tang, University of California, Los Angeles conceived a synthesis using an engineered Enzyme and a product low-cost feed stock. Codex Inc;optimized both the Enzyme and Chemical process. The resulting process greatly reduces hazards and waste,is cost effective and meets the needs of coustemers.Some manufacturers in Europe and India use this method to make Simvastatin.

To Assist with Green Chemistry Education ,EPA (Environmental Protecting Agency)supports Several projects including the development of material and course to students (5).In order to implement the Green chemistry technology the ACGSI(American Society Green Chemistry Institute)has launched a new initiative to reach out Business School to create scholarly net work that links various Schools and Green chemistry communication(6) The success of Green chemistry depends on training and education of new generation Chemist. A course at degree level has to be introduced to practice Green chemistry. As it has been observed that usually students learn a set of basic chemistry principles and procedures but they are not aware of the input they use(Petroleum based feed stocks versus renewable or bio based. They are Usually not aware about the ultimate nature of the thing Is it biologically active? Does It bio-accumulate or bio persist).All this broader contexture issues are the host of Green Chemistry and this is how chemistry should be taught (7).

The time calls for the implement of Green chemistry at undergraduate levels to science courses So as to make students aware of environment at issues and efforts going on Worldwide to address this issues (8).Co-operation of Green chemistry in curriculum in some foreign Universities has Fueled a fundamentally new approach of teaching chemistry.(9)To practice and increase the research in Green chemistry field we need to publise the need, Efforts and practice of Green chemistry. Thus the awareness of Green chemistry among undergraduate Level is highly essential and by introducing chemistry at all levels, the Government an build a Strong Foundation towards Green chemistry in India. This paperanalyses the Green Chemistry awareness results among 1 degre science students of Bangalore city colleges.

Materials and Method:

To assess the awareness in Green chemistry for sustainable growth. Few good colleges of Bangalore with good Grades from NAAC (National Assessment &Accreditation Committee) were selected under the following categories:(1)Deemed Universities. (2) Autonomous Colleges (3) Private Aided Colleges(4) Private Unaided Colleges (5) Government Colleges.

In order to obtain full and relevant information from the students from the above mentioned Institutions a Questionnaire was prepared by the investigator. The Questionnaire consisted of 35 questions and being a multiple choice had four answers for each question. The students were Provided with OMR sheets to circle their correct answers.Before giving the questionnaire to the students, a brief presentation about Green chemistry for sustainability was made by the Investigator to explain the basic principles of Green chemistry to the students . The Questionnaire was designed in such a way that it covered all the fundamentals and Basic Questions needed for the awareness of Green Chemistry.

Sample Size: The sample consisted of the students from different categories as mentioned above. The number of students in each category is shown in Table -1

Table-1 Sample Size- No of Students under various Categories

Sl No	Name of the Category	Name of the Institution	NO of the Students	Total No of Students
1	Deemed univ.	IISC;	58	247
2	Deemed univ.	Jain Univesity	10	
3	Autonomous	National Coll.	26	
4	Autonomous	NMKRV	20	
5	Autonomous	Joythinivas	23	
6	Pvt.Aided Coll.	Vijaya College	23	
7	Pvt.Aided Coll.	BMS	10	
8	Pvt.Un Aided	BHS Vijaya	23	
9	PVt.UnAided	The Oxford	13	
10	Government	Govt.Science	22	
11	Government	Maharani's Coll	19	

It can be seen from the above table that a total number of two hundred and forty seven(247)students answered the Questionnaire.

Experimental Investigations

The Green chemistry awareness results obtained from the students of various Institutions were assessed Depending upon the number of correct answers from the OMR answer sheets of students. These results are shown in Table-2 .

Table-2 Awareness Levels among Students

Well aware	Fairly aware	Partly aware	Poorly aware
28	65	119	35

It can be observed from the above Table that the results are categorized under four levels of awareness as follows:

- 1. Well aware level:** Students who obtained percentage between 100-80% by getting 35-28 correct answers from the questionnaire.
- 2. Fairly aware level:** Students who obtained percentage between 79-60% by getting 27-21 correct answers correct from the questionnaire
- 3. Partly aware level:** Students who obtained percentage between 59-33% by getting 20-12 correct answers from the questionnaire
- 4. Poorly aware level :** Students who obtained percentage between 32-20% by getting 11-7 correct answers from the questionnaire.

The percentage of each level of awareness of the various institutional categories was calculated and is tabulated in Table-3.

Table-3 Awareness levels percentages among various Institutional Categories

Sl NO	Name of Category	Well Aware	Fairly Aware	Partly Aware	Poorly Aware	No of Students
1	IISc; Deemed	41 %	43%	16%	0.0%	58
2	Jain Deemed	10%	30%	50%	10%	10
3	Autonomous	03%	26%	60%	11%	69
4	Pvt.Aided	02%	30%	32%	36%	33
5	Pvt.Un Aided	0.0%	20%	74%	06%	36
6	Government	0.0%	05%	64%	31%	41

It can be observed from the Table -3 that the well aware and Fairly aware percentage of IISc; is highest among all institutions being 41% and 43% respectively .The partly aware percentage is 16% where us Poorly aware percentage is Zero.. The percentages of awareness levels of other Institutional categories can be clearly seen from Table-3

The graphical representation of the above mentioned results of various institutional categories can be seen from Fig-1.

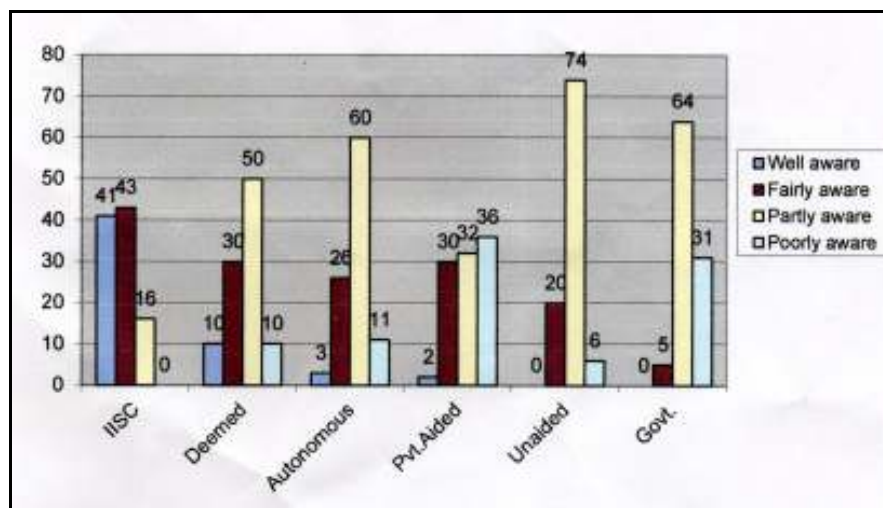


Figure-1 Awareness among Students of various Institutional categories

The above figure -1 clearly shows the percentages of each levels of awareness for the various institutional categories.

Table-4 Percentage awareness of Various Institutions

Sl No	Institution ame	Well ware	Fairly aware	Partly aware	Poorly aware	Students
1	IISc;	41%	43 %	16%	0.0%	58
2	Jain Deem univ.	10%	30%	50%	10%	10
3	National College	04%	30%	53%	23%	26
4	NMKRV College	05%	20%	70%	05%	20
5	JyothiNivas Coll.	0.0%	39%	57%	04%	23
6	Vijaya College	04%	31%	43%	22%	23
7	BMS College	0.0%	30%	20%	50%	10
8	BHS Vijaya Coll.	0.0%	17%	70%	13%	23
9	The Oxford Coll.	0.0%	23%	77%	0.0%	13
10	Govt.Sci.Coll.	0.0%	0.0%	64%	36%	22
11	Govt.Maharanis	0.0%	11%	63%	26%	19

Table-4 shows clearly the percentages of different levels of awareness of various Institutions which were investigated in the present study.

The graphical representation of the above mentioned institutions results shown in Figure -2 as Follows:

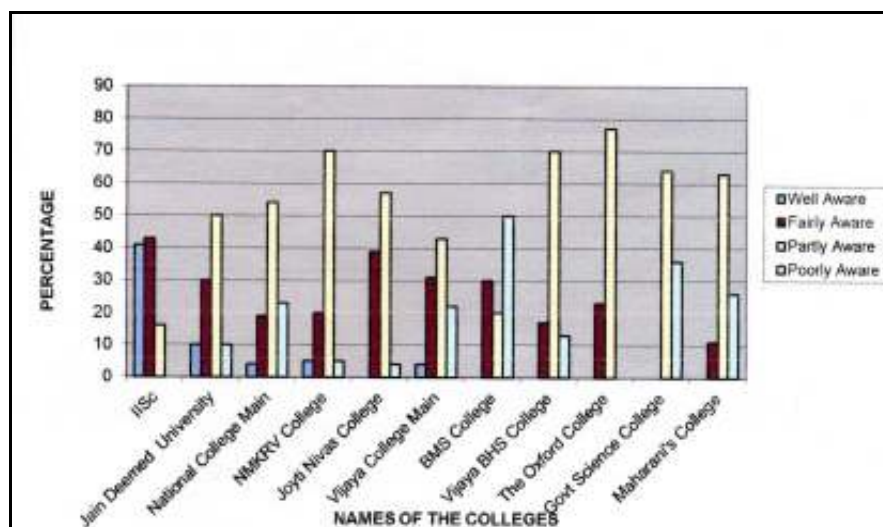


Figure-2 Awareness among Students of various Institutions

The above figure-2 clearly shows the percentages of the various levels of awareness among different Institutions studied.

Results and Discussions:

Statistical computations by Chi-Square Test have been used for the results analysis. The Chi-Square (X^2) measures the difference between observed (O) and expected (E) frequencies of nominal variables in which subjects are grouped in categories or Cells. The Chi-Square uses the formula as follows:

$$X^2 = \sum (O-E)^2 / E$$

Where the letter O represents the observed frequency, the actual count in a given cell. The letter E represents the Expected frequency, a theoretical count for that cell. Its value must be computed. The more O differs from E, the larger X^2 is. When X^2 exceeds the appropriate critical value, it is declared significant.

The chi-square Tests can be used on actual numbers and not on percentages. The results of number of students, Female and Male of the various institutions in present study are calculated and is shown in Table-5 as follows:

Table-5 Number of Female (F) and Male (M) Students of various Institutions

Sl no	Name of the Category	Institution Name	Well Aware	Fairly Aware	Partly Aware	Poorly Aware	No of Students
1	Deemed	IISc;	F 5, M 19	F 7, M 18	F 6, M 3	F 0, M 0	58
2	Deemed	Jain Univ	F 1, M 0	F 3, M 0	F 4, M 1	F 1, M 1	10
3	Autonomous	National College	F 1, M 0	F 1, M 4	F 8, M 6	F 2, M 4	26
4	Autonomous	NMKRV	F 1, M 0	F 4, M 0	F 14, M 0	F 1, M 0	20
5	Autonomous	Jyoti Nivas	F 0, M 0	F 9, M 0	F 13, M 0	F 1, M 0	23
6	Pvt.Aided	Vijaya	F 1, M 1	F 4, M 3	F 6, M 4	F 2, M 3	23
7	Pvt.Aided	BMS College	F 0, M 0	F 3, M 0	F 2, M 0	F 5, M 0	10
8	Pvt.Aided	BHS College	F 0, M 0	F 4, M 0	F 12, M 4	F 1, M 2	23
9	Pvt.UnAided	Oxford College	F 0, M 0	F 02, M 1	F 6, M 4	F 0, M 0	13
10	Government	Govt.Science college	F 0, M 0	F 0, M 0	F 7, M 7	F 3, M 5	22
11	Government	Maharani's College	F 0, M 0	F 12, M 0	F 2, M 0	F 5, M 0	19

The above table shows the number of **female** (F) and **male** (M) students in various awareness levels of different institutions.

The data tabulated in the above Table-5 was subjected for carrying out the **Chi-Square Test** for testing two Hypotheses.

Hypthesis -1 : There is no association between levels of awareness and type of Institutions.

Hypthesis-2: There is no significant difference in awareness levels among Female and Male students.

The computation of X^2 test statics data obtained for testing the for Hypothesis -1 and Hypothesis -2 are tabulated in Table-6 and Table -7 as follows:

Table-6 Chi-Square test statics data of Association of type of institution And level of awareness

Type of Institution	Level of Awareness				Total
	Well Aware	Fairly Aware	Partly Aware	Poorly Aware	
IISc	24 (6.6)	25 (5.3)	09 (27.7)	0.0 (8.2)	58

Deemed	0 1 (1.1)	0 3 (2.6)	0 5 (4.8)	01 (1.4)	10
Autonomous	02 (7.8)	18 (18.2)	41 (33.2)	08 (9.8)	69
Pvt.Aided	01 (3.7)	10 (8.7)	12 (15.9)	10 (4.7)	33
Un Aided	0 1 (4.1)	07 (9.5)	26 (17.3)	03 (5.1)	36
Govt.	0.0 (4.6)	02 (10.8)	26 (19.8)	13 (5.8)	41
Total	28	65	119	35	247

* Significant at 5% level

Figures in parenthesis are expected counts/Frequncis.

pearson Chi-Square Value =121.89

Asymptotic significance =0.000*, Significance at 5%

Table-7 Independent t-test result to test awareness gender wise

Group	-N	df	Mean	Mean difference	S.E	t-value	p-value
Male	88	246	10.56	-5.79	0.745	-4.184	0.000*
Female	159		16.35		0.942		

Interpretation:

As observed from **Table-6**, the chi-square value of 121.89 and a P-value of 0.000 ($0.000 < 0.05$) indicates that the null hypothesis of no association between the type of institution and level awareness is rejected statically at 5% level of significance. In other words, there is evidence (Statistically) that there is an association between type of institution and level of awareness. In other words, the level of awareness among students definitely depends on the kind of institution the students are enrolled.

The independent t-test result shown in **Table-7** is carried out to test the Hypothesis -2

Interpretation:

It is observed from the above t-test out put as shown in **Table-7** that the mean difference (**5.79**) between **Male** and **Female** students is Statistically significant ($t = -4.184, p = 0.000 < 0.05$).

In other words, there is a significance difference on awareness between **male** and **female**

Irrespective of the type of institution. As the mean score of female (**16.35**) is greater than

Male (**10.56**) students, one would conclude that female students are better as compared to their counterpart in awareness.

Conclusions

1. The Overall results of Green chemistry awareness levels among first year degree Science students indicates that the awareness levels depends on the type of Institution. Thus the students of IISc have very good percentage awareness in both well aware and fairly aware levels.
2. The Female students' awareness is better than Male students irrespective of the type of Institutions.
3. It is possible to Educate and train the young talented students by proper course in Green chemistry. Students at all levels have to be introduced to practice of Green Chemistry. Green chemistry cannot enter wide spread practice until Chemists learn it during Academic and Professional training.
4. The good education and practice of Green chemistry in USA Universities is producing good results. To mention one of the recent examples is the 'New method to produce Green Steel Reported from

Massachusetts Institute, USA .The researchers have a new method through which steel melting, one of the World leading Industrial source of Green House effects can be made completely Green and Carbon free.The results were published in International Journal NATURE.(2013).

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