



# Greener and Safer Chemistry Labs – A study in Intermediate and UG Institutions

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## Abstract

Chemistry education is instrumental in guiding research towards sustainable development. With rapidly evolving chemical knowledge, Chemistry education is instrumental in guiding research towards sustainable development. With rapidly evolving chemical knowledge, we must prioritize enhanced lab safety and adopt greener, more sustainable approaches. To study safety aspects and greener approaches in various institutions we adopted survey method with questionnaire; awareness method through presentation, and demo method through demonstration of greener approaches to be followed in the chemistry laboratories as per the curriculum. In the conventional method of qualitative analysis of inorganic salts and organic functional group analysis, the usage per student will be 1 to 2 ml in a lab, but in the greener approach the same can be done in a drop using groove tile spot test kit. In the volumetric analysis, a pipette is replaced with burette towards the safer and greener approach. These approaches minimize the wastage, usage and saves lot of time and energy with the yield of same results. We personally visited five (5) intermediate colleges and virtually interacted with fifteen (15) colleges of intermediate and UG level, and took survey, created awareness and demonstrated the greener approaches/ shared the videos of the greener experiments. Only less than 5% of intermediate colleges and 50% of UG colleges are following few safety measures but not all. Coming to the greener approaches none of the intermediate college is following the above mentioned greener approaches and only 2 colleges (10 %) are using groove tile. So there is a need to create awareness on experiments that are redesigned in both safe and sustainable way. Apart from this, to widespread the value of green chemistry to tomorrow's chemists and allied subjects to the maximum extent, a national level workshop is conducted on 04/03/2023. The feedback analysis of the workshop was rated excellent and the knowledge gained by the participants before and after attending the workshop was rated moderate to excellent. Greener and safer approaches go side by side in order to minimize pollution and maximize efficacy on human health and environment. we must prioritize enhanced lab safety and adopt greener, more sustainable approaches. To study safety aspects and greener approaches in various institutions we adopted survey method with questionnaire; awareness method through presentation, and demo method through demonstration of greener approaches to be followed in the chemistry laboratories as per the curriculum.

**Keywords:** Green chemistry; Safer labs; Groove tile

## Introduction

Chemistry education can play an important role in directing the chemical research for sustainable development (Sharma et al., 2024, Krishna et al., 2021). Nowadays there is drastic improvement in the growth of chemistry knowledge. Behind the positive results of chemical research, there is a negative result of environmental pollution through chemistry labs. There is an increased water and air pollution due to excessive use of chemicals and toxic fumes, leading to environmental pollution. Lab safety is the one of the very important aspect of science without it experimentation could result in serious accidents and injuries which lead to again chemical pollution (National Research Council (US) Committee on Prudent Practices in Laboratory, 2011). Therefore, lab safety is to be ensured and greener approaches are to be adopted (Ménard et al., 2020).

Total No. of students in Higher Education in India as per 2016-17 data is 3,57,00,000 (three crore fifty-seven lakhs). Chemistry Subjects students in HE is 25% of 3,57,00,000 = 89,25,000. Let us assume the wastage of chemical per student per experiment is 1(one) gram. If we assume 30 experiments, then the wastage per student will be 30 grams. Wastage per Year will be 30 X 89,25,000 = 26,77,50,000 gram=2,67,750 KG. Assume average cost of chemicals per KG is Rs. 500 /-. Amount of money wastage per year will become 2,67,750 X 500 = Rs. 13,38,75,000 (Thirteen Crore

thirty Eight lakh seventy five thousand). In order to reduce such huge quantity of wastage from chemistry labs, Greener approaches are to be adopted. Few greener aspects followed by our study include Grove tile method (Mahaveer et al., 2023) and Double burette method. Grove tile method is used for the inorganic and organic qualitative analysis, which reduces the chemical usage and wastage. Double burette method is used in volumetric analysis of oxalic acid/ Mohr salt versus  $\text{KMnO}_4$  titrations, which also reduces the chemical usage and wastage; reduces environmental pollution. This experiment also saves lot of time too. The other advantage of adopting this green approach experiments in the curriculum will save lot of money. Hence greener approaches are to be adopted. The main motto of our work is to study and create awareness on lab safety measures and to adopt few green approaches in the chemistry labs in the intermediate and UG institutions of Nalgonda district, Telangana, India.

### Methodology

To study lab safety measures and greener approaches in institutions; To create awareness on lab safety measures and greener approaches; To adopt and follow the greener approach methodology in the qualitative analysis of inorganic salts and organic functional group analysis which is present in the Intermediate and UG curriculum; To adopt and follow the greener approach methodology in the volumetric analysis of oxalic acid/ Mohr salt versus  $\text{KMnO}_4$  titrations which is present in the Intermediate curriculum (National Council of Educational Research and Training; 2018). To study safety aspects and greener approaches in various institutions we adopted, Survey method with questionnaire; Demo method through demonstration of greener approaches to be followed in the chemistry laboratories as per the curriculum; awareness method through poster presentation and national level workshop.

#### I. Survey questionnaire Method:

The following are the Survey questionnaire adopted to measure the safety and greener aspects. The survey is been divide into four sections, Section A is about Infrastructure in the College, Section B will survey on preparedness of teaching and non-teaching staff, Section C includes the safety and greener approaches adopted in lab, and Section D includes the use of ICT in practical teaching- learning.

#### II. Demonstration method:

As per the curriculum and as per the availability of resources demonstrations of the following experiments are carried out.

##### **Spot Test/ Grove tiles for organic/inorganic tests**

In the conventional method of qualitative analysis of inorganic salts and organic functional group analysis, the usage per student will be 1 to 2 ml in a lab, but in the greener approach the same can be done in a drop using grove tile spot test kit.

##### **Double burette titration method**

In conventional method volumetric analysis, pipette and a burette are used. The chemicals should be sucking in through the pipette while performing titrations. The disadvantage of pipette-burette method is after one titration; the chemicals were flushed out and perform another titration. We should perform the titrations until we get concordant set of readings.

Disadvantages of conventional method volumetric analysis

It causes a lot of environmental damage.

It requires a large amount of water while flushing.

Sucking can cause health issues if it goes into body.

In Double burette titration method of volumetric analysis, a pipette is replaced with burette towards the safer and greener approach. These approaches minimize the wastage, usage and saves lot of time and energy with the yield of same results. To overcome these disadvantages double burette method is used. It involves the use of burette instead of pipette. While performing the titrations, no throwing of chemicals is done, further titrations are done in the same flask.

Advantages Double burette titration method of volumetric analysis:

We can get the endpoint with little amount of chemicals.

No sucking of chemicals, thus decreases health issues.

No throwing of chemicals after one titration, environmental pollution saved to some extent.

#### III. Awareness Method

Awareness has been conducted in all the colleges by visiting colleges and presenting posters of safety symbols and safety measures

National Level workshop is conducted to widespread the importance of greener and safer aspects of the laboratories.

## Results and Discussions

Our study includes twenty (20) intermediate and UG level colleges. In that five (5) Degree Colleges and remaining fifteen (15) are from intermediate colleges. We personally visited five (5) intermediate colleges and virtually interacted with fifteen (15) colleges of intermediate and UG level, and took survey, created awareness on safety aspects and demonstrated the greener approaches/ shared the videos of the greener experiments like the qualitative analysis of inorganic salts and organic functional group analysis. As this experiment will make a drastic improvement in the pollution control. We also demonstrated greener approach methodology in the volumetric analysis of oxalic acid/ Mohr salt versus  $\text{KMnO}_4$  titrations which is present in the Intermediate curriculum. This experiment will lot of time especially. The colleges visited by us are as follows, Kendriya Vidyalaya Nalgonda; Little flower Girl's junior college, Nalgonda; Government Junior college for Girl's, Nalgonda; Neelagiri Junior college, Nalgonda; Komati Reddy pratheek Memorial Government Junior Boys College, Nalgonda; Nalanda Degree College, Nalgonda; Kakatiya Degree College, Nalgonda; Pragathi Junior College, Nalgonda; Gowtami Junior College, Nalgonda; Geetanjali Junior College, Nalgonda; Alpha Junior College, Nalgonda; Saptapadi Junior College, Nalgonda; The Nalgonda Junior College, Nalgonda; Vinutna Junior College, Nalgonda; Deepthi Junior College, Nalgonda; Govt. Degree College for Women, Nalgonda; Nagarjuna Govt. Degree College, Nalgonda; Siddartha Degree and PG College, Nalgonda; Neelagiri Degree and PG College, Nalgonda; Sri Vidya Bharathi Degree College, Nalgonda.

Only less than 5% of intermediate colleges and 50% of UG colleges are following few safety measures but not all. Coming to the greener approaches none of the intermediate college is following the above mentioned greener approaches and only 2 colleges (10 %) are using groove tile. So there is a need to create awareness on experiments that are redesigned in both safe and sustainable way. The faculty shared the pictures with us on the implementation of Lab safety measures and greener experiments in few colleges. This is an immediate outcome of our work. Future outcome is to conduct the national level workshop to widespread the value of green chemistry to tomorrow's chemists and allied subjects to the maximum extent. Greener and safer approaches go side by side in order to minimize pollution and maximize efficacy on human health and environment. Spread the message that Chemistry is SAFE only when it is GREEN.

### Survey Analysis Parameter wise

College Name 1: Kendriya Vidyalaya, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans Available	Safety symbols, first aid measures, fire extinguisher, sand bucket, eye washing station
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Non Teaching staff is not aware of it	Lab staff Should be aware of safety symbols, MSDS.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	No	Lab coat, Eye protective glass, Hand gloves, MSDs referred lab staff before use of chemicals, derivative library should maintain with proper labelling, date of preparation, safety symbols on any solution, groove tile, empty bottles should be recycled
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	No	To Use presentation tools, To record videos of Experiment ,.

College Name 2: Little flower Girl's junior college, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans , fire extinguisher available.	Sand buckets, eye washing station, first AID measures, heating mantle.
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Non Teaching staff is not aware of it	Should be aware of MSDS, safety symbols, handling fire extinguisher

C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	No	Health doctor, MSDS, safety symbols, first AID kit, date of preparation, segregation of chemicals, Use spot test kit in groove tile.
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	No	Google Classroom, presentation, Videos.

## College Name 3: Government Junior college for Girl's, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans Available	First aid posters, exhaust fans, gas burners sand buckets, Eye washing station
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Non Teaching staff is not aware of it	Should be aware of lab staff about safety symbols, MSDS, trained them on handling fire extinguisher.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	No	Lab coat, Eye protective glass, Hand gloves, MSDs referred lab staff before use of chemicals, derivative library should maintain with proper labelling, date of preparation, safety symbols on any solution, groove tile, empty bottles should be recycled
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	No	Use presentation tools, record video of Experiment ,MOODLE, proprietary LMS of instructions.

## College Name 4: Neelagiri Junior college for Girl's, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans Available	Safety symbols, first aid measures, fire extinguisher, sand buckets, Eye washing station
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Non Teaching staff is not aware of it	Should be aware of safety symbols, MSDS sand trained on handling fire extinguishers
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	recycling of container	First aid kit, safety symbols, MSDS, health doctor, date of preparation, lab coat, segregation of chemicals, groove tiles.
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Presentation tools, visual videos of experiments ,Google Classroom	

## College Name 5: Komati Reddy pratheek Memorial Government Junior Boys College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.

C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 6: Nalanda Degree College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 7: Kakatiya Degree College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 8: Pragathi Junior College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols

B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 9: Gowtami Junior College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 10: Geetanjali Junior College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 11: Alpha Junior College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's	Sand buckets, Eye washing station safety symbols

		and Don'ts, lab safety measures posters.	
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	Should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 12: Saptapadi Junior College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	Should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 13: The Nalgonda Junior College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

## College Name 14: Vinutna Junior College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

## College Name 15: Deepthi Junior College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

## College Name 16: Govt. Degree College for Women, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Eye washing station
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF		should be aware of MSDS and safety symbols.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library,

D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	
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College Name 17: Nagarjuna Govt. Degree College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 18: Siddartha Degree and PG College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 19: Neelagiri Degree and PG College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.

C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

College Name 20: Sri Vidya Bharathi Degree College, Nalgonda

S.No.	Parameters in Survey form	Already in practice/ available	Suggestions for further improvement and any other Remarks
A	INFRASTRUCTURE	Exhaust fans, gas burner, heating mantles, fire extinguisher, do's and Don'ts, lab safety measures posters.	Sand buckets, Eye washing station safety symbols
B	PREPAREDNESS OF TEACHING AND NON-TEACHING STAFF	Handling fire extinguisher	should be aware of MSDS and safety symbols, training in safer and greener lab practices.
C	SAFETY AND GREENER APPROACHES ADOPTED IN LABS	First AID kit	Group style, clinic doctor, MSDS, derivative library, date of preparation, segregation, recycling of containers
D	USE OF ICT IN PRACTICAL TEACHING-LEARNING	Google Classroom	Presentation, videos

Safety Aspects	No. of Colleges implemented / percentage
Do's and Don'ts	15/20 (75%)
Segregation of Chemicals	5/20 (25%)
Safety Symbols Display	10/20 (50%)
Exhaust fans	20/20 (80%)
First Aid Kit	16/20 (80%)

As per results of survey, it is found that none of the college is following "all the safety measures" in their institution. The greener approaches like Groove tile method for inorganic and organic qualitative analysis is also followed by none except two degree colleges.

### Conclusion

Only less than 5% of intermediate colleges and 50% of UG colleges are following few safety measures but not all. Coming to the greener approaches none of the intermediate college is following the above-mentioned greener approaches and only 2 colleges (10 %) are using groove tile. So, there is a need to create awareness on experiments that are redesigned in both safe and sustainable way. Within few days of our visit to Kendhriya Vidhyalaya, Nalgonda started implementing one of our suggestions like writing Date of preparation on Reagent bottle. The faculty shared the pictures with us on the implementation of Lab safety measures and greener experiments in few colleges. This is an immediate outcome of our work.

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#### Author Contributions

Jyothi B conceived the concept, wrote and approved the manuscript.

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