

# THE EFFECTIVENESS OF HANDS-ON ACTIVITY TEACHING IN LEARNING ACID AND BASE CONCEPTS AT THE SECONDARY LEVEL

**Amar Srivastava**

*Associate Professor, Chemistry Department*

*D.A.V. College, Kanpur-208001, U.P.*

*E-mail: asri1406@gmail.com, +91 9415172471*

Acids and bases are encountered at every walk of life and their concept is very essential for students. This paper reports the conceptualisation of acids and bases and their identification using synthetic and natural indicators with the help of simple investigations. A study was done on 50 Class VII students of United Public School of Kanpur district of Uttar Pradesh, by making two groups of 25 students each. The students were put in Group A with odd roll numbers while the students with even roll numbers were put in Group B. Group A was taught this concept in traditional way while Group B was taught through investigative hands-on activity approach. An investigative technique using pre- and post-test have been used. The pre- and post-test questionnaire consisting of 25 questions were made and the tests were executed. The response sheets were collected and analysed. The results clearly showed that the Group B with hands-on activity learnt and performed significantly better and there is a significant increase in learning and understanding of the concept of acids and bases. On further analysing the responses it was found that the students of Group B were able to answer High Order Thinking Skill (HOTS) questions in a much better way than the students of Group A. Thus, it can be seen that there is a significant increase in learning and understanding of the concept by the students of Group B. They showed better skill development and were able to draw conclusions correctly. The investigative approach created interest and curiosity in them about the subject. The hands-on activity generated a feel of the subject. The students, for the first time, went to do some experiments on their own. They learnt the concept of acids and bases through doing themselves. This led to a much better learning and performance. Thus, the objectives of the research project were fulfilled.

**Key words:** *Acid-base indicators, synthetic and natural indicators, universal indicators, hands-on activity.*

## Introduction

The acids and bases play a very important role in everyday life. It has a significant role in the digestion of food, tooth decay, soil fertility and plant growth, acid rain, defence mechanism of plants and animals, and many more. The sour and bitter taste of the food are due to acids and bases (or alkalies), respectively, present in them. We know that acids are sour in taste and they change the blue litmus indicator to red. The bases, on the other hand, are bitter in taste and change the red litmus to blue. Thus, a clear concept of acids and bases and their distinction and identification is essential for students at the secondary level.

## Objectives

To make the students aware about acids and bases, the answers to the following questions be searched;

- How can acids and bases be identified?
- How can a substance more acidic or more basic than the other be identified?
- What are natural acid-base indicators?
- What are synthetic acid-base indicators?
- What are universal indicators?
- What should be given to a person suffering from indigestion due to

overeating baking soda or vinegar? And so on.

**Hypothesis:** Hands-on activity teaching is more effective than traditional (chalk and talk) teaching.

## Methods and Procedure

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**Tools:** An investigative technique using pre- and post-test has been used. The pre- and post-test questionnaire consisting of 25 questions were made. Some of the questions are given below.

1. The vinegar is sour in taste. Is it acidic or basic in nature?
2. If a food is bitter to taste, will it be acidic or basic in nature?
3. A substance turns blue litmus solution to red. Is the substance acidic or basic in nature?
4. Does turmeric powder turn red from yellow in presence of acidic or basic substances?
5. Is turmeric powder or an acid-base indicator or stain indicator?
6. Are litmus solution and turmeric powder synthetic or natural indicators?
7. Is phenolphthalein colourless or red in acidic medium?
8. Phenolphthalein turns pink in basic medium. Is it an acid-base indicator or stain indicator?
9. Is phenolphthalein a synthetic or natural acid-base indicator?
10. Can vinegar (acetic acid) and hydrochloric acid be detected by litmus solution or universal indicator?
11. Can ammonium hydroxide and sodium hydroxide be detected by phenolphthalein or universal indicator?
12. Can ammonium hydroxide and acetic acid be detected by litmus solution, phenolphthalein or universal indicator or all of these?
13. What should a person suffering from acidity be given— baking soda or vinegar.

**Sample Size and Selection Procedure:** The Class VII of United Public School of Kanpur District of Uttar Pradesh consisting of 50 students was grouped into two Groups— A and B of 25 students each. The groups were made through random selection. The students were put in Group A with odd roll numbers while the students with even roll numbers were put in Group B.

**Materials:** Some acidic and some basic food items, some natural indicators namely, turmeric powder and litmus solution, some synthetic indicators namely, phenolphthalein and universal indicator were taken.

**Procedure:** After grouping the students in two groups— A and B, as indicated earlier, a pre-test was administered. A questionnaire containing 25 questions was distributed to both the groups, a briefing was done and students were asked to answer them, with full honesty, in the given stipulated 20 minutes. The response sheets were collected and later analysed.

On the next two days, the students of Group A, now treated as the test group, were

taught the concept of acids and bases in the normal traditional way using chalk and talk method.

After Group A, the students of Group B were asked some questions (already given in the objectives of this project so as to create interest and curiosity in the subject and interactions in the class). They were allowed to conduct the experiment and also to draw the inferences themselves. When they were allowed to taste certain common foods such as curd, vinegar or lemon, they called them sour to taste and identified them as acids. Similarly, they found certain other foods as bitter in taste and identified them as bases. After this, they were asked to identify the acidic and basic substances through acid-base indicators. The students used turmeric powder and litmus solution to distinguish acids and bases. They also repeated the experiments with a synthetic indicator— the phenolphthalein. The abrupt colour change in both natural and synthetic indicators filled them with curiosity and enthusiasm. The answer to the question— how can we identify the strength of two acidic or two basic substances was solved

activities, a test was conducted to see the effect.

On the next day, a post-test was conducted. It was done by distributing a questionnaire consisting of 25 similar questions to the students of both the Groups A and B. The students were asked to answer them with full honesty, in the given stipulated time of 20 minutes. The response sheets were collected and analysed.

## Results and Discussion

The results show much better conceptualisation of acids and bases by the students of Group B. Now they are able to distinguish between acids and bases. They are also able to identify them using natural as well as synthetic indicators. Apart from this, they can also tell which is a stronger acid or a stronger base between the two with the help of universal indicator.

The responses given by students of both Groups— A and B for the pre- and post-test were analysed, and are shown below in Table 1:

**Table1: Response of Students in Pre-test (out of 25 questions)**

| Group | Number of correct answers<br>Pre-test | Number of correct answers<br>Post-test |
|-------|---------------------------------------|--|
| A     | 6                                     | 12                                     |
| B     | 7                                     | 23                                     |

by using universal indicator. The universal indicator is a mixture of several dyes and it produces different colours at different pH, i.e., at different acidities or basicities. After two days of learning by doing, i.e., hands-on

On further analysing the responses it was found that the students of Group B were able to answer High Order Thinking Skill (HOTS) questions in a much better way than the students of Group A. Thus, it can be

seen that there is a significant increase in learning and understanding of the concept of acids and bases in the students of Group B. They showed better skill development and were able to draw conclusions correctly. Thus, the objectives of the research project were fulfilled. The investigative approach created interest and curiosity in them about the subject. The hands-on activity generated a feel of the subject. The students, for the first time, conducted some experiments on their own. They learnt the concept of acids and bases by themselves. This led to a much better learning and performance.

## Conclusion

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Based on our results, we can conclude that our hypothesis is correct, i.e., the hands-on activity based teaching is more effective than traditional (chalk and talk) teaching.

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## References

- NCERT. 2015. *Science*, Textbook for Class VII, New Delhi.
- . 2015. *Science*, Textbook for Class IX, New Delhi.
- SCERT, U.P. 2015. *Science*, Textbook (*Vigyan*), for Class VII, Basic Siksha Parishad, U.P.