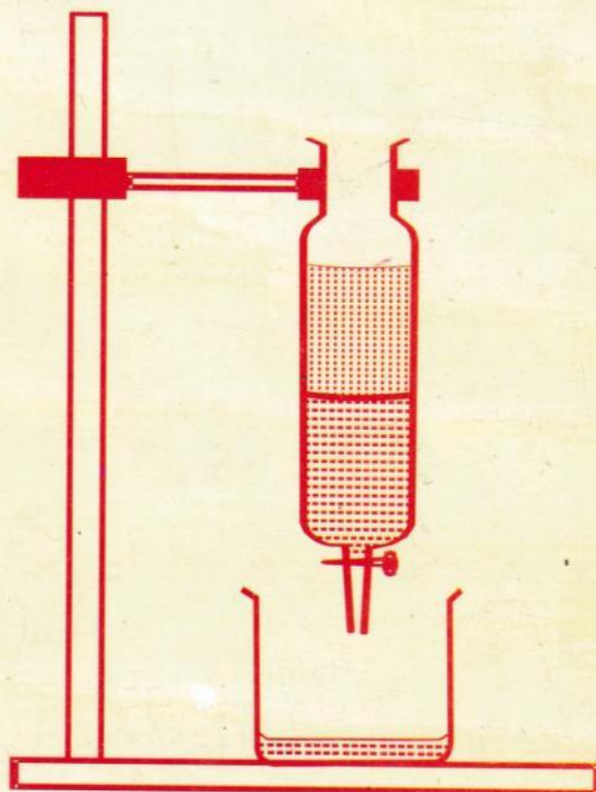


SCIENCE TEACHERS
ASSOCIATION OF NIGERIA

CHEMISTRY PANEL SERIES 7

**TEACHING
NATURE OF MATTER &
SEPARATION TECHNIQUES**



**A HANDBOOK FOR
CHEMISTRY TEACHERS**

Published in 2011 by
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ISBN 978 125 812 21

Printed in Nigeria by
MacChin Multimedia Designers, Zaria.
080865118186, 07052687603, 08068527586

PAPER 23

CO-OPERATIVE LEARNING STRATEGY FOR TEACHING SEPARATION OF COMPLEX MIXTURES: A SHIFT FROM THEORY TO PRACTICE

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Introduction

Teaching science concepts requires regular and active participation of learners through the use of authentic classroom activities. This is to enhance understanding, reasoning, interest and application of knowledge gained in solving day to day problems. The teacher's success in the classroom rests strongly on the use of appropriate method/strategy in teaching /learning process. The strategy used can mar or evoke profound learning and achievement of stated objectives.

According to Osisioma (2005), teachers should identify teaching strategies that are comfortable and suitable for the class, based on its content and objectives. Many strategies that are active and innovative like concept mapping, cooperative learning, demonstration, computer-based instruction , field trips, project, and constructivism have been recommended as effective and efficient in promoting science teaching and learning(Ayodele; 2002, Nnaka and Anaekwe 2004; Ososioma, 2005, and Njoku, 2007). Nnaka and Anaekwe (2004) agreed that co-operative learning strategy facilitates student's performance in sciences and other related subjects

However, Njoku, (2007) noted that Nigerian science teachers do not adopt teaching strategies that research have indicated as effective and efficient in promoting and maximizing learning outcomes

Corroborating the statement, Nsofor (2002) opined that most of the science teacher's interaction with students is by lecture method and note copying, resulting in rote memorization.

Practical experience in any science class is crucial for real understanding of principles and application of knowledge gained for cognitive growth and technological development, (Anderson, 2004). Hence, a shift from lecture method commonly used by science teachers to an active learning strategy, co-operative learning strategy, in

teaching chromatography to SSI students is the focus of this paper.

Co-operative Learning Strategy

Co-operative learning strategy is an active teaching/learning strategy which encourages small groups of students to work together for the achievement of common goal. In co-operative learning, the teachers' role changes from a 'sage' on stage to a 'coach' guiding by the side.

Osisioma (2005) defines co-operative learning as a type of active learning strategy which students work in a more formally structured group rather than alone. This is done through multiple step activities, to achieve common goal.

Active involvement of learners implies encouraging classroom participation through hands-on-minds-on activities to arrive at solution of science and technology based problems (Njoku, 2007).

Eniayeju, Akpan and Eniayeju (2005), observed that co-operative learning promotes motivation, self efficacy and self regulation. Although students learn in groups, the students are evaluated individually. Hence, chromatography analytical technique is activity based Chemistry concept, and as such requires the use of use of co-operative learning that will enhance students' involvement and development of skills.

What is Chromatography?

Chromatography is an analytical technique used for separating complex mixtures which involves a stationary phase and mobile phase. The term chromatography is obtained from two Greek words *chroma*, meaning *colour*; and *graphy* meaning *write*. Chromatography analytical technique was first employed by a Russian scientist, Michael Tswett in 1906 to separate various pigments (colours) found in leaves. The technique is now widely used to separate both coloured and colourless substances. In separating colourless substances, ultra-violet illumination or some chemicals on

the adsorbent is usually used to convert the colourless into coloured substances.

The adsorbent materials (stationary phase) commonly used include aluminum oxide, charcoal, starch, calcium trioxocarbonate (IV), porous paper and ion-exchange resins, while the solvent (moving phase) often used include petroleum ether, benzene, propanone, trichloromethane, water and hexane.

Separation of mixtures depends on the physical properties of the constituents of mixtures. These properties include states of matter (solid, liquid and gas), sizes, melting point, boiling point, solubility and densities of the constituent of the mixture. Mixtures can be separated by filtration, distillation, crystallization, winnowing, chromatography, evaporation, sublimation among others.

Separation of mixtures using Chromatographic method generally involve two distinct phases: the stationary phase (adsorbent material) and the moving phase (solution). The separation depends on competition for molecule of sample between the moving phase and the stationary. The degree of retention is obtained by passing solvent through the stationary phase which dissolves the substance and carries it as it moves. A solute which is held more strongly by the stationary phase travels more slowly in the flowing solvent than those held less firmly. The component of mixture moves at different rates and produce chromatograms. Hence, the position of each chromatogram is constant relative to the mobile phase, and is expressed in terms of:

Retention factor (R_f) =

(distance moved by the sample, x) / (distance moved by the solvent, y) = (x / y)

(where x/y is the distance and it is less than 1).

The technique is widely used in the analysis of foods, drugs, blood, petroleum products, colours (ink) and radioactive fission.

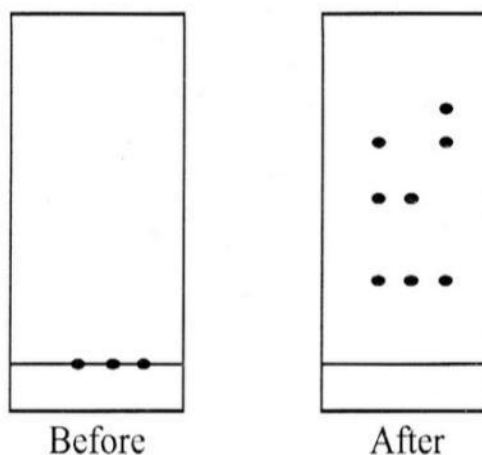
Types of Chromatography

Classification of chromatography can be based on the mobile phase as liquid chromatography and gas chromatography. Liquid chromatography involves the use of soluble materials while gas chromatography uses volatile substances. It can also be classified as partition chromatography e.g. paper chromatography; adsorption chromatography or Ion-exchange chromatography.

Paper chromatography

This is the simplest chromatographic method commonly used in the laboratory to separate complex

mixtures, like ink and chlorophyll. In paper chromatography, filter paper is used with the mixture concentrating in a small spot close to the edge of the paper. The paper is dipped into a jar containing the solvent (mobile phase). As the solvent flows past the spot, the moving solvent dissolves the solute, which moves with it. A solute which is more soluble in the solvent moves up the filter paper faster than the one which is less soluble. The filter paper is then removed, dried to identify the colours. Chromatography may be by ascending or descending method. This diagram below shows an ascending chromatography and is suitable for separating complex organic mixtures.



Thin layer chromatography (TLC):

This is similar to paper chromatography in procedure. However, glass plates coated with absorbent e.g. silica gel or CaSO_4 is used instead of filter paper. Thin layer chromatography (TLC) is more suitable when reagents are too corrosive for paper. This technique is used for analyzing liquid mixtures.

Column Chromatography

In this type of separation, a liquid, usually water, is absorbed onto the surface of a suitable solid such as silica gel. The gel is packed in a tube with a tap at the bottom, through which the sample to be analyzed is poured into the column and continuously washed through with the solvent. This method can be used to separate plant pigments.

Vapour chromatography (VC)

This is also known as gas chromatography because the same principle is applied to the adsorption of gases or vapour by a liquid. A column of adsorbent powder, such as kieselguhr, is wetted with an involatile liquid, such as hydrocarbon oil. Steady flow of a carrier gas like nitrogen, hydrogen or

carbon (IV) oxide is passed through the column, and the mixture of gases or vapour to be analyzed is fed into the stream of carrier gas before it enters the column. It is a cheap method for analyzing complex volatile mixtures such as those found in petrol, oils, gas and alcohol level in blood.

Lesson Plan

Subject: Chemistry

Class: SS 1

Topic: Separation of mixtures (chromatography)

Duration: 40 minutes

Gender: Male and female

Teaching method: Co-operative learning

Lesson objectives:

By the end of the lesson, the students should be able to

- Explain the term chromatography
- Mention three types of chromatography
- Demonstrate the separation of ink as a complex mixture
- List materials/solvent used in the process of separating ink and state their functions.
- Draw and label clearly the diagram showing the separation process.

Instructional Materials

Filter paper, gas jar, rod, cello-tape, biro pen (red or blue or black) propanone or ethanol.

Entry Behaviour

The teacher reviews the lesson on mixtures by asking the following questions

- What is a mixture?
- Give 5 examples of mixtures
- How can you separate the mixtures mentioned above.

Strategy

Step 1: The teacher divides the class into groups of 4 or 5 and provide with necessary materials.

Step 2: The teacher should define chromatography, state types of chromatography and draw diagram to illustrate them.

Chromatography is a separation technique used in separating complex mixtures of gases, liquid or dissolved substances.

Step 3: The teacher guides the student to carry out the separation of mixture (ink) or leaves extract as follows:

Activity for Students

- Cut a rectangular strip of filter paper 12cm x 2cm
- Draw a line about 2 cm from either ends of the paper.
- Make a deep ink spot in the middle of the base line.
- Suspend the paper with the spotted end into 20 cm³ of ethanol in the beaker; cover the beaker with glass trough.
- Observe the set up until the solvent rises up to the top line.
- Remove the paper and measure the distance of each new spot.
- Repeat the experiment using extract from leaves.
- Report your observations. What conclusion can you draw from the experiment?

Step 4: Evaluation: The teacher monitors the progress in each group and reinforce their understanding of the principle by asking the following questions

1. Why did you choose chromatography technique in separating the experiment above?
2. What are the functions of filter paper and propanone?
3. Can water be used in the place of propanone? Give reason(s) for your answer

Group discussion and questions

Conclusion

The strategy used by the teacher in teaching plays a crucial role in enhancing learning and student's performance. Co-operative learning is an active and innovative teaching/learning strategy, which can bring about effective teaching and learning. It promotes student's interest and maximizes student's involvement in the teaching/learning process. It is therefore recommended that chemistry teachers should use this instructional strategy to enhance learner's participation and performance in chemistry.

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