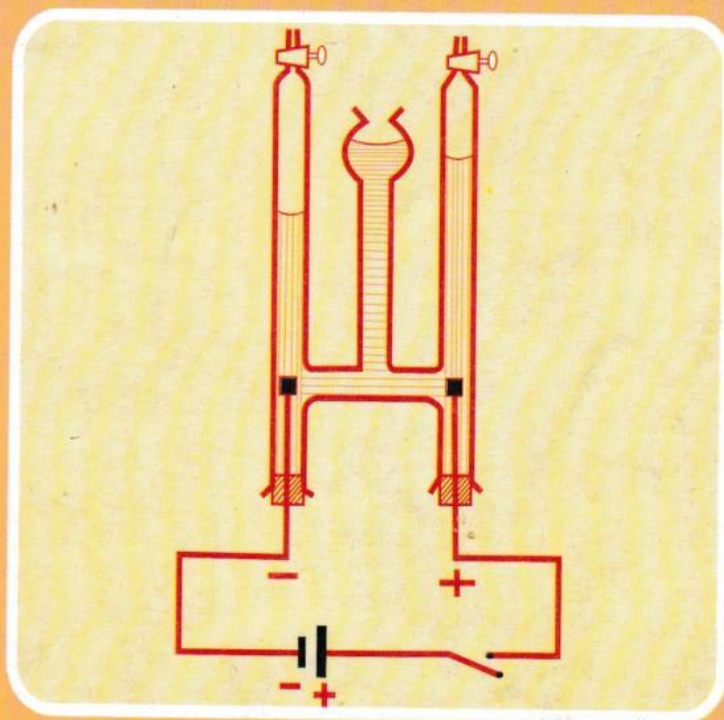


**SCIENCE TEACHERS
ASSOCIATION OF NIGERIA**

CHEMISTRY PANEL SERIES 6

**TEACHING
ELECTROCHEMISTRY**



**A HANDBOOK FOR
CHEMISTRY TEACHERS**

**SCIENCE TEACHERS ASSOCIATION OF
NIGERIA**

CHEMISTRY PANEL

SERIES 6

**APPROPRIATE TECHNIQUES FOR TEACHING
ELECTROCHEMISTRY**

**A HANDBOOK FOR
CHEMISTRY TEACHERS**

Editors:

Godwin O. OJOKUKU *mstan*

Ebenezer O. AMADI *mstan*

PROBLEM SOLVING: AN APPROPRIATE STRATEGY FOR TEACHING CALCULATIONS IN ELECTROCHEMISTRY

Theresa Udofia

Department of Science Education, University of Uyo, Uyo.

Introduction

Teaching and learning play a central role in education. It is a twin process which takes place in the classroom. During teaching, students are trained to solve problems, demonstrate, communicate and interact with one another. Science, especially chemistry, by its nature and definition as a body of knowledge and process has its own words, symbols, diagrams and notations which requires effective teaching for students to learn meaningfully.

Teaching in Nigerian schools is increasingly involving new methods such as process approach, inquiry, problem solving and laboratory approach (Shodeinde, 1999). There are different teaching strategies many of which interlink and can be used collaboratively in teaching. Babarinde (2009) admits that there are several teaching strategies for knowledge transfer but not all of them are effective in transferring knowledge.

According to Rarnsden (2003), teaching includes aims of the curriculum, method of transmitting knowledge, assessment of students and evaluation of the effectiveness of the instruction. This implies that for meaningful teaching/learning to take place, the teacher must be able to select and use teaching strategies that are appropriate for the topic being taught as well as caters for students' interest.

In chemistry, nearly all the topics in the curriculum depend on the mathematical principles and so the student's ability to analyze problems and relate them to appropriate laws, principles and equations is the first step to solving problem. Research finding by

Onwu and Ahiakwo (1985) shows that secondary school students encounter difficulty in learning electrochemistry because it involves quantitative problems.

However, innovative teaching strategies have been advocated by researchers as being effective in teaching science subjects. Notably among them are problem solving strategy by Ahiakwo (1991), target task approach by Eze (2002) and mastery learning by Adepoju (2002). Unfortunately, Ajeyalemi (2002) reported that teachers were not utilizing these methods of instructions. Barry and King (1997) asserted that teacher's success in the classroom hinges on the use of appropriate teaching strategies to impart knowledge to the students. Thus the method of teaching used by the teacher can mar or enhance learning. Invariably, appropriate selection and effective utilization of teaching strategies differentiate a creative and effective teacher from the mediocre.

However, Nwagbo (1999) indicates that many science teachers shy away from innovative activity-oriented teaching method such as concept mapping, inquiry, discovery, co-operative and problem solving techniques. Okoye (1998) defined strategy as design or steps taken to achieve desired aims, objectives and goals. Thus the use of innovative teaching strategy such as problem solving in teaching calculations in electrochemistry involves the breaking down of quantitative problem into steps to enhance greater exploitation of mental ability in solving problems. This helps the teacher to impact effectively and meaningfully on the students.

Problem-solving strategy in the teaching of Chemistry

Chemistry as a subject is made up of topics which require complex mental processes that involve visualizing, manipulating, analyzing, abstracting and associating ideas.

Frazer (1982) defines problem-solving strategy as a bridge between a problem and solution by using information (knowledge) and reasoning. Thus, in problem solving strategy, the following features are common:

Two things exist which are problem and solution.

The problem-solver is active and needs to possess relevant information about the problem.

The problem-solver needs to think and reason in line with the nature of the problem.

The problem-solver needs to apply every previous knowledge and intuitive knowledge to solve problem.

It is the ability to solve problems that makes teaching/learning effective, meaningful and rewarding. From the foregoing, problem solving strategy involves the breakdown of quantitative problem into step-by-step instruction, so that a student can systematically comprehend, critically analyze and solve problems without cramming.

Steps in using problem solving strategy

In order to solve problem successfully using this strategy, students must possess the following abilities:

- Read and comprehend what the problem is all about.
- Relate the problem to previous ones or recall facts, formula, laws, theorems or experiences relevant to the problem at hand.
- Translate the problem sentence to mathematical symbols where necessary.
- Determine the most appropriate operation in solving the problem.
- Carry out correct computational procedure to arrive at the desired solution.
- Crosscheck the steps and answer to confirm that they are all correct.

Sample Lesson Using Problems Solving Strategy

Lesson: Calculations in Electrochemistry

Teaching Method: Problem solving strategy

Objective: At the end of the lesson, students should be able to calculate problems in electrolysis using step-by-step approach.

Question: During the electrolysis of copper (II) salt, the quantity of electricity passed was 4825 C.

Calculate the mass of copper deposited
($1F = 96500C$, $Cu = 63.5$).

Presentation

Step 1: Clarify the problem by identifying what is required.

The mass of copper (Cu) deposited is required.

Step 2: Relate the problem to formula, equation and Faraday law.

Copper (II) salt ($CuSO_4$) contains Cu^{2+} , SO_4^{2-} , OH^- and H_3O^+ ions.

Cu^{2+} is discharged and deposited as copper metal at cathode.

Thus: $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

Step 3: Translate the equation to mathematical symbol.

Recall: $1F = 1 \text{ mole of electrons} = 96,5000C$

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

i.e. $2F$ deposit 1 mole of Cu (mole of $Cu = 63.5g$)

Step 4: Evaluate from known to unknown

$2F$ deposit 1 mole of Cu

i.e. $2 \times 96,500 C$ deposit 63.5 g of copper

$1 C$ will deposit $(\frac{63.5}{2 \times 96500}) g$

$\therefore 4825 C$ will deposit $(\frac{63.5 \times 4825}{2 \times 96500}) g$ of Cu

$= 1.59 g$ of Cu

i.e. $4825 C$ of electricity will deposit $1.59 g$ of copper metal.

Step 5: Check the steps and answer again to confirm the answer and follow up with more problems

Step 6: Provide more questions for the students to strengthen the practice.

Advantages of problem solving strategy

- Correct use of the strategy evokes high level of thinking as students apply their knowledge to similar problem in other fields.
- It promotes self-confidence and independent participation in the class activities.
- It promotes organizing observations and systematic presentation of data.
- It enhances skill development – like cognitive, computational and communicative skills – among others.
- It promotes interaction among students.

Summary

Problem-solving strategy involves step-by-step instructions, which are defining or clarifying of problem, collecting information, reasoning through the problem, computation, evaluation and rechecking the steps to confirm the answer. Regular exposure of students to varieties of problems strengthens the practice, develop self confidence, facilitate criti-

cal thinking and develop skills. The teacher should show commitment by allotting enough time for the students to work on their own as well as provide feedback and corrections to the problems.

References

- Ahiakwo, M. J. (1991). Cognitive style and students' problem solving competency in chemistry. *Journal of Science Teachers Association of Nigeria*. 27 (1). 31-39.
- Adepoju, A. A. (2002). Mastery Learning Strategy and Secondary School Teaching. In S. O. Ayodele (Ed.) *Teaching Strategies for Nigerian secondary schools*. Ibadan: Power House Press. 85-92.
- Ajeyalemi, D. A. (2003). Capacity building in sciences: *Imperative for teacher education in Nigeria*. Inaugural lecture series. University of Lagos: Unilag Press.
- Barry, K. and King, L. (1997). *Beginning Teaching*. Australia: Social Science Press. Retrieval 28th June 2006 from <http://station05.qu.ca/css/cybersite/reachout/strategies/teaching.htm>
- Babarinde, K. (2009). Strategies for Effective Knowledge Transfer. In L. Popoola, O. Adetimirin and O. Olorunnisola (Eds.). *Planning and Writing Grant Oriented Proposals. Proceedings of a Training of Trainers Workshop*. University of Ibadan, Ibadan.
- Eze, C. U. (2002). Effect of Target Task Approach on Students' Achievement in Senior School Certificate Physical Chemistry. In M.A.G. Akale (Ed.) *Proceedings of the 43rd Annual Conference of Science Teachers Association of Nigeria*. Heinemann Books Plc 259-262.
- Nwagbo, C. R. (1991). Effect of Guided Discovery and Expository Teaching Methods on the Attitude towards Biology Students of Different Levels of Scientific Literacy. *Journal of Science Teachers Association of Nigeria*. 34(182) 66-73.
- Okoye, C. O. (1998). An evaluation of the 1971 mineral resources policy of Nigeria. *Journal of Environmental Sciences*. 2(1) 87-93.
- Rarnsden, P. (2003). *Learning to Teach in Higher Education*. Rutledge, London.
- Selvarantnam, M. and Frazer, K. (1982). *Problem solving in Chemistry*. London: Heinemann Books.
- Shodeinde, A. O. (1991). New methods and techniques in teaching and learning. Paper presented at ETF workshop. Ibadan. December.