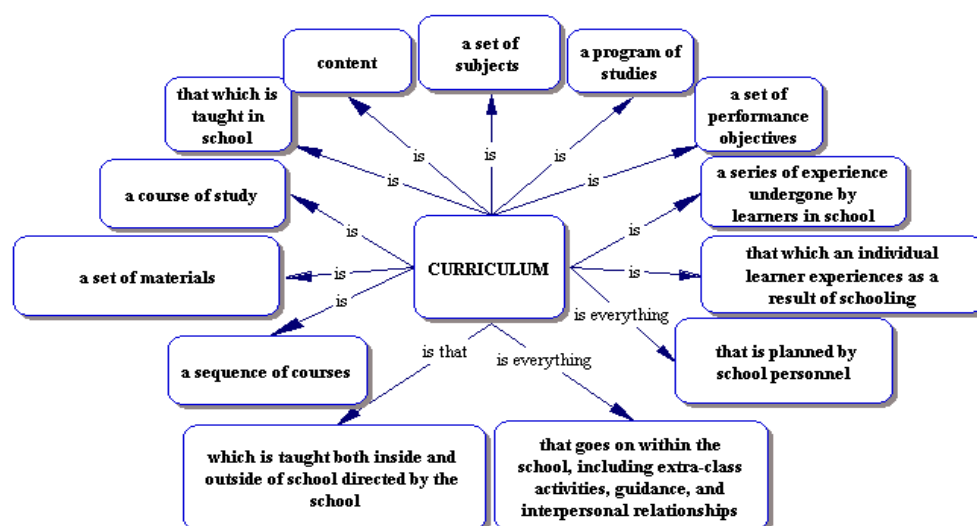


CTM431: Chemistry Teaching Methods II

MODULE 3

Making curriculum decisions in the teaching of Chemistry



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Acknowledgements

The Copperbelt University College, Science Department wishes to thank the following for their contribution to this module:

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About this Module

This module is structured as outlined below.

How this module is structured

The module overview

Welcome to the module on Chemistry Teaching Methods

This module is part of the CTM330 Course in the Bachelor of Education Science programme. The module discusses the curriculum process and the role of action research in improving the teaching of chemistry.

To complete this module successfully, you will need to spend three (3) hours per week studying the module, and make sure you work out all the activities in each unit. Don't move to another unit before you understand the previous unit. In case you need help contact the course tutors.

You are expected to do all the self marked activities and one tutor marked assignment which will accompany this module. You are required to submit the assignment to the nearest resource centre in your district. This module has five units.

We strongly recommend that you read the overview *carefully* before starting your study.

Module outcomes



Outcomes

Upon completion of this module you will be able to:

- Describe the curriculum process/development
- .Discuss the aspects of curriculum evaluation
- Discuss the characteristics of Action research.
- Discuss the role of Action research in improving the teaching of chemistry
- Apply the principles of Action Research to solve the problems related to the teaching of identified to be difficult

Need help?



Help

Should you require help in the course of your studies, do not hesitate to contact the following course tutors

Mr Mweshi E Cell: 0955-881340 / 0969-218224

E. Mail: emweshi@yahoo.com

Getting around this Module

Margin icons

While working through this module you will notice the frequent use of margin icons. These icons serve to “signpost” a particular piece of text, a new task or change in activity; they have been included to help you to find your way around the module.

A complete icon set is shown below. We suggest that you familiarize yourself with the icons and their meaning before starting your study.

 Activity	 Assessment	 Outcomes	 Note it!
 Summary	 Help		

Unit 1

Curriculum Process

1.0 Introduction

In this unit we are going to discuss the aspects of curriculum process that are key in development and evaluation of the curriculum. Thus upon completion of this unit you will be able to:



Outcomes

- Define the curriculum
- Describe the curriculum process
- Discuss the stages of the curriculum process.
- Relate the curriculum process to the chemistry lesson plan

1.1 What is the Curriculum process?

Before we answer this question it is important to understand what the curriculum is. A curriculum in general sense refers to all subjects and the period of study for a particular grade, course or programme. School curriculum is defined as a specification of the desired knowledge capabilities, skills, values and activities which pupils in Zambia need to acquire or achieve. A curriculum in the context of a chemistry lesson can be defined as a specification of the desired knowledge, skills, values and activities which pupils need to acquire in a chemistry lesson. It is therefore a sum total of all planned teaching and learning experiences.

A subject curriculum contains planned learning and teaching experiences for a particular subject. E.g. chemistry curriculum covers all the work taught from grade 10 to 12.

A syllabus refers only to the planned learning content relevant to a specific subject and grade.

A curriculum is present as a plan in form of a syllabus, schemes of work, a lesson plan and as the actual chemistry lesson in the classroom.

The figure below presents different views of what the curriculum is.

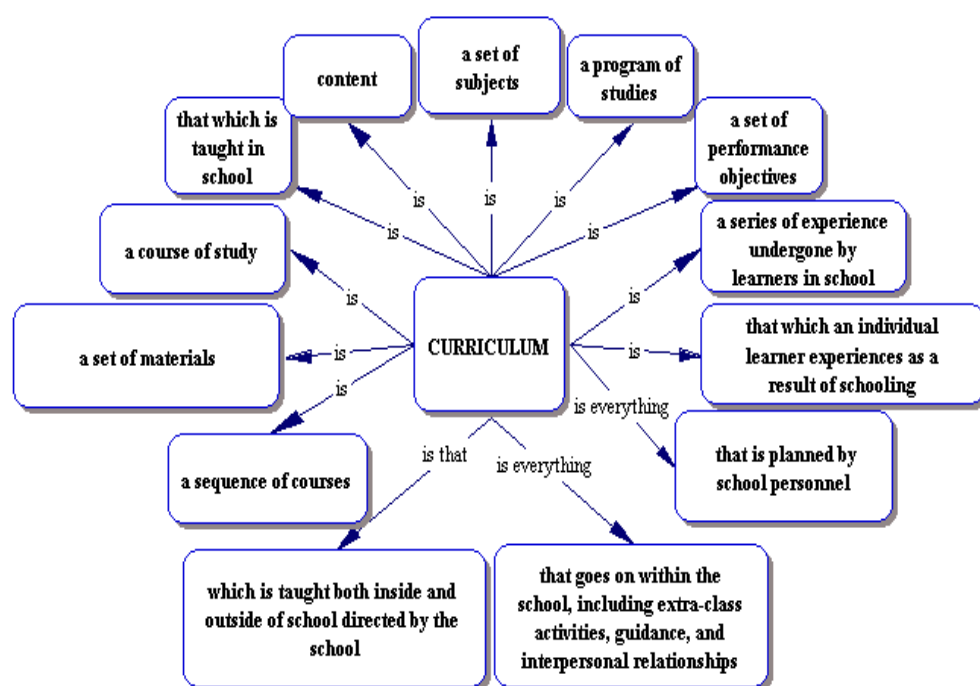


Figure 1 . Classification of curriculum definitions (Oliva,1982)

1.1 Models for Curriculum Design (Process)

There are various different types of curricular so does there development process. However there are general models of the curriculum process presented by various scholars. It is important to note that any curriculum process should always start with the identification of the need, expectations or requirements of the key stakeholders in education. In general terms, the following are the key stakeholders in education;

1. The pupils/students
2. The government
3. The teachers
4. The society (labour market or employers)
5. The academic world.

Expectations, needs and requirements of the stakeholders should be translated into curriculum goals and aims (philosophical framework). The government requires that the curriculum should help them achieve the goal of education in their manifesto or policy. Society's need the curriculum is that is able produces responsible individuals who will fit well in the society on the basis of responsibility and hard working character.

The Labour market or employers demand the curriculum equips the graduates with knowledge, skills and attitudes that will enable them to cope professional specific competences in the field.

The academic world demands that the curriculum meets the standards and prepares learners to pursue higher courses and programmes.

After the needs are identified they are translated into the aims goals and objectives of the curriculum. Let us now discuss some of the curriculum represented models developed by some of the scholars.

Hilda Taba's Model

Hildah presented the following 7 steps of curriculum design.

1. Diagnosis of needs
2. Formulation of objectives
3. Selection of content
4. Organisation of content
5. Selection of learning experiences (activities to engage pupils)
6. Organisation of learning experiences
7. Determining of what to evaluate and how

Nichole's Model

Nicole proposed five steps in curriculum development and what Taber called the diagnostic needs analysis he labelled it situation analysis.

1. Situation analysis
2. Aims and objectives (i.e. formulation of aims and objectives)
3. Selection and clarification of content/organisation
4. Design of learning opportunities and experiences
5. Evaluation

Tyler's Model

The Tyler's model consists of five steps or phases

1. The selection of aims, goals and objectives
2. Selection of learning experiences
3. Selection of content
4. Organisation and integration of learning experiences and content
5. Evaluation of the effectiveness of all aspects of phases 2, 3, and 4 in attaining goals.

The basic assumption for this model is that, the end of education is to change behavior and it should be a continuous process (cycle process).



It is important to note that Tyler's model does not implicitly indicate the need for situation analysis indicated by Nichole or diagnosis of needs by Taba as the first step in the curriculum process. The situation analysis is very important in that it gives an insight of the environment in which the curriculum will be implemented in terms of the needs, opportunities and challenges.

Curriculum process defined.

The curriculum process is the inter-related totality of aims, learning content, teaching and learning activities, opportunities and experiences and evaluation procedures which guide the implementation of the learning experiences in a planned and justified manner.

Let us now discuss the steps of the curriculum process

1. Situation Analysis

This is a very vital element (or stage) in the curriculum development. It involves the analysis of the elements of the environment in which the curriculum will be implemented. It also looks at the needs of the key stakeholders in education. It involves the needs of people (teachers and learners), institutions, (schools), society, government policy, labour market and academic world to which the curriculum relates.

Important variables linked to situational analysis

The following are the key variables that you need to consider during the situation analysis

a) Learner

The following features of a learner should be put into consideration.

- *Social and cultural economic status of the learners:* These demographic information needs to be understood for the curriculum to be feasible and meaningful. Take for example if the curriculum demands that the main approach that will be used to implement it is e-learning, the following questions should be addressed: What is the social and cultural status of the majority of our learners in Zambia in terms of the attitude and use of ICT? Can they afford to buy e-learning devices? If these issues are not addressed they might pose as challenges to the implementation of the curriculum

- *Level of cognitive (intellectual development)*. It is important whatever planned and learning experiences in the curriculum should be at the intellectual ability of the target group of learners
- *Level of affective (emotional development)*: This addresses the question emotional maturity to handle the learned content and participate meaningfully in learning experiences.
- *Ability of a child to handle and value what they are learning*. Are the pupils able to handle and appreciate the learned material so that it becomes part of them?
- *Level of psychomotor development* It is important to include activities in the curriculum that will be handled by the learners and that will develop their body co-ordination.

b) Teacher

The following aspects of the teachers should be considered

- Personal qualities and teaching styles
- Professional competencies
- Subject content knowledge

c) learning content (subject)

- It is very important to consider the Scope of content to be taught and sequence of how the content topics in the curriculum process.
- The learning content should be in correlation with all the components of the curriculum i.e. aims, goals and objectives and learning experiences which are also in correlation with the needs and aims of the stakeholders.

d) Society

- The society has specific needs and it makes specific demands on the curriculum.
- Society expects the curriculum to be up to date with current development and future trends.

e) Environment

Many of the influencing factors that should be considered in planning an situational curriculum are

- *Logistical potential*: This includes infrastructure, funds, material resources needed for the implementation of the curriculum
- *Administrative structure*: The function of a curriculum is determined by the nature of the internal administrative structure and the efficiency of the system.
- *Mission, aims and vision*: The mission, vision and aims of a school echoes the schools reception of its mandate from the community.

2. Aims, goals and objectives

This refers to, in general terms, the knowledge, skills and attitudes the curriculum intends to achieve.

The aims serve as;

- Basis for selecting learning content
- Acts as a core determines of the teaching methods
- Provides necessary guidelines and criteria for evaluating the effectiveness of teaching.

3. Learning content

The learning content is a means for teaching and educating the learners with a view of achieving the aims of the curriculum.

4. Teaching and learning opportunities and experiences

This part involves one question of how the selected learning content should be taught and learned to reach the desired learning outcomes (aims).

5. Evaluation

This is a process of determining the extent to which the aims and assumptions of the curriculum have actually been achieved.

Evaluation reflects upon and provides value judgment concerning the quality and the effectiveness of teaching and learning experiences/opportunities.

The process is directed at diagnosing shortcomings in the actualization of the didactic activities (learning and teaching opportunities) with the view of remediation adjustment and improvement.

This process of evaluation can be considered under the following headings or parts.

a) Evaluation of stated goal and behavior

This is the formal purpose of evaluation which is the evaluation of the stated goal and stated behaviour. Questions answered at this stage are:

- (i) Did the expected behaviour occur?
- (ii) Did pupils actually acquire knowledge, skills, attitudes, beliefs and values that were intended?

- (iii) Did the learners habitually respond in the expected ways?

b) Evaluation of operations that were performed in each proceeding phase

The second part has to do with the evaluation of operations that were performed in each proceeding phase. Questions answered at this stage are;

- (i) Where the teaching and learning experiences and content chosen suitable for the attainment of goals?
- (ii) Would other experiences perhaps could have been more suitable?
- (iii) Did different organizations/institutions contribute to the achievement of the curriculum goals?



ACTIVITY 1.1

Discuss each stage of the curriculum process in the context of a chemistry lesson plan as a curriculum which you develop as a teacher

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1.2 Curriculum Evaluation

When doing evaluation the following behaviours should be considered seriously.

(1) **Initial behaviour**

This is the behaviour an individual or group displays before any educational experience (i.e. the curriculum educational experience).

(2) **Actual outcomes**

This is the behaviour resulting from an educational experience.

(3) **Intended outcomes**

These are specified behaviours in the goals set in phase one or in the curriculum.

In order to make adequate plans to change behaviours, it is vital to know where to start from (i.e. it is vital to know the initial behaviour of learners). This means that specific objectives or outcomes cannot be properly determined until some assessment of the initial behaviour has been done.

Evaluation of any educational experiences (curriculum) rests upon the difference between initial behaviour and actual outcomes and the relationship between these two bear on the intended outcomes. Measures of how far the pupil has come and how far he/she still has to go are fundamental to the curriculum process. Curriculum process must therefore be represented as a cycle.

The general aim of education may remain the same but the society in which they must be realised is dynamic thus the need to redefine the goals from time to time through the evaluation process.

1.3 Challenges faced by curriculum process

The following are some the challenges faced by the curriculum process

- How to close the gap between the intentions of the curriculum and realities of classroom. That is how to close the gap between plan and implementation of the curriculum (courses, syllabi, schemes, lesson plans etc).
- How to select the best or simply what is best to achieve the aims, goals and objectives.
- Many scholars have identified the fundamental factors in the education circles as; Learners, Society and Organised subject matters (specialized divisions of the curriculum). And the challenge is how to treat or how to harmonize the needs and the demands of these factors in the curriculum process. John Dewery points out that, if we treat these factors in isolation or we focus on one at the expense of others, we may end up with insurmountable problems of categorisim such as the child versus the curriculum, individual nature versus social culture e.t.c. There should be harmony interactions with nature and needed growth of the learners and with goals and ideas of a democratic society

**ACTIVITY 1.2**

How best can you overcome the following challenges in the chemistry lesson?

(a) The gap between the intentions of the curriculum and realities of classroom

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(b) How to select the best or simply what is best to achieve the objectives of a chemistry lesson.

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Unit summary

In this unit we discuss the curriculum process, which is the process of: identification of the needs and the demands of the following stakeholders in the curriculum; students, government, society and the academic world through the process of diagnosis of needs or situation analysis; translating those needs and demand into curriculum aims, goals and objectives; selection and organisation of suitable content and learning experience to achieve the curriculum aims, goals and objectives; and the processes evaluating effectiveness of all aspects of phases 2, 3, and 4 in attaining goals. Curriculum process is always faced with the following challenges; how to close the gap between the intentions of the curriculum and realities of classroom, how to select the best or simply what is best to achieve the aims, goals and objectives and how to harmonize the needs of the stakeholders.

Assessment



Assessment

1. Discuss the benefits of using ICT in the teaching and learning of chemistry.
2. Describe the main features of computer assisted learning
3. Discuss is the status of your school in terms of the use of ICT in teaching of chemistry

Unit 2

Action Research in the teaching of chemistry

2.0 Introduction

In unit 1 we discussed the curriculum process, and in this unit we are going to discuss research as a tool to identify and solve some the challenges to with the implementation of the curriculum so as to improve curriculum decisions and practices

During and upon completion of this unit you will be able to:



Outcomes

- Define research
- Identify the differences between pure and action research.
- Discuss the characteristics of action research
- Discuss the phases of action research
- Apply the phases of action research in solving the identified problem affecting the effectiveness of teaching and learning of chemistry

2.1 What is research?

Before discussing what action research is, it is important to understand what research is and the parts of a research as some of you did not take a research course in third year.

Research is a broad and multi-dimensional concept with a lot of definitions. However the following definition by P.M. Cook seems to capture most of the dimensions of research.

Research is an honest, exhaustive, intelligent and systematic process of searching for facts and their meanings or implications with reference to a given problem. It is the process of arriving at dependable solutions to problems through the planned and systematic collection, analysis and interpretation of data. The best research is that which is reliable, verifiable and exhaustive so that it provides information in which we have confidence.

Let us now in a broad sense discuss the classification of research

Classification of research

Research can be classified under three broad categories: basic or fundamental research, applied research and action research. It must be, however, be not forgotten that the lines of demarcations between these categories are not very clear. In many ways they appear to overlap one another.

Basic research or fundamental research

This is also called pure research it is concerned with the solution of fundamental problems and major issues. It gives results in form of broad generalizations or principles and theories. It aims at the discovery of some basic truths and laws and is not immediately

concerned with direct field application. In education the discovery of useful concepts such as motivation, reinforcement, concept formation in learning are as a result of fundamental type of research.

Applied research

This type of research is also called field research. It is primarily concerned with finding results of which find direct application in the field. It is preferably devoted to the problems of the field workers or other affected individuals. It is more interested in the theories, principles, or laws which work. A fundamental research may propound a theory or discover a law and stop at that. But applied research is concerned primarily with the testing of such theories or laws in the actual field setting.

Action Research

Action research is similar to applied research in so many ways. The only difference can be that applied research may be carried out on a large sample resulting into more universally applicable findings. While action research is primarily conducted on the immediately available small sample in order to solve the immediate problem for the same group. Action research is undertaken by educational practitioners, like you, because they believe that by so doing they can make better decision and engage in better action. The teachers, supervisors and administrators would make better decisions and engage in more effective in more effective practices if they conducted research as a basis for those decisions and practices.

The differences between pure research and action research are summarized in the table below

Table 2.1 Comparison of Fundamental and Action research

Aspects	Fundamental Research	Action Research
Objectives	Its purpose is to develop and test educational theories and to obtain universally applicable principles	Knowledge obtained is intended to be applied in local setting. It also provides a sort of in-service training to participating field workers.
Expertise	Expert training is needed in measurement research methodology and statistics	Only ordinary training may suffice. Action research can be done by an average teacher under the guidance of a consultant
Locating the research problem	A wide range of methods and vast process is used to locate the research problem	It deals with the problems which hinder class-room teaching-learning process. Thus participating teachers can easily identify them.
Involvement	The research worker may not be personally involved in the problem selected for research	The teacher is invariably involved in the research problem
Hypotheses	Highly specific and well stated hypotheses are formulated and adapted.	Only the specific statements of the problem serve as hypothesis
Review of literature	It necessitates an exhaustive and thorough review of literature in order to have a complete understanding of the accumulated knowledge in the area.	It demands simply a general understanding of the area. There is no need for a thorough and intensive review.
Sampling	A random or otherwise unbiased sample of the population is studied	Pupils studying in the particular class taught by the teacher are used as study unit or subjects.
Design	Careful attention is paid to maintain comparable conditions thus reducing error and bias	Procedures are planned only in general terms.

Let us now briefly discuss the types of research

Types of Research

Research can either be qualitative or quantitative

Qualitative Research

This form of research involves descriptions. It seeks to describe and analyze culture and behavior of human beings and their groups from the point of view of the researchers. Qualitative research uses the natural setting, for instance, a classroom setting and not a laboratory. This means that the scenario is not artificial. Qualitative research relies on the research strategies that are flexible and interactive. This includes interviewing, focus group discussions and questionnaires. In qualitative research, feelings and insights are considered important.

Quantitative Research

Quantitative research relies on the principle of verifiability. That means confirmation, proof, corroboration or substantiation. Knowledge emerges from what can be proven by direct observation. The researcher's values, interpretation and feelings are not considered. The researcher tries by all means to detach from the study units or respondents. It focuses on the establishment of the cause - effect relationship. Quantitative focuses on measurements i.e. the assignment of numerical events according to rules.



ACTIVITY 2.1

Discuss the importance of the three classes of research in education

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Now you understand what research is, the classification of research and the types of research. Let us now discuss action research

2.2 Action Research?

The following definition by Saunders (2012) of what action research is, captures all the aspect of action research discussed in the previous section.

Action Research is an emergent and iterative process of inquiry that is designed to develop solutions to a real problem through a participative and collaborative approach.

Action research uses different forms of knowledge, and which have implications for participants and beyond. It involves both research specialist and class room teachers in the study and application of research to educational problems in a particular classroom setting.

Characteristics of action research

- Action Research focuses on immediate application, not on the development of theory or on general application. It places its emphasis on a problem here and now, in a local setting
- Its findings are evaluated in terms of local applicability, not universal validity.

- Its purpose is to improve school practice such as management and teaching and learning processes, at the same time, to improve the participants (those who want to improve the practice): by combining the research processes, habits of thinking, ability to work harmoniously with others, and professional spirit.
- It is emergent and iterative.

Thus this is the type of research which classroom teachers should get involved in, because it is the best way for them to improve curriculum decisions and local classroom practices.

The following five themes are identified with the definition and characteristics of action research; purpose, process, knowledge and implications

The purpose of an Action Research strategy is to promote organizational learning to produce practical outcomes through identifying issues, planning action, taking action and evaluating action. It is about research in action not research about action. This is because action research focuses on addressing worthwhile practical purposes and resolving real issues.

The process of Action Research is both emergent and iterative (characterized with repetition of action). An action research starts within a specific context and with a research question but because it works through several stages or iterations the focus may change as the research develops. Each stage of the research involves a process of diagnosing or constructing issues, planning action, taking action and evaluating action as shown below.

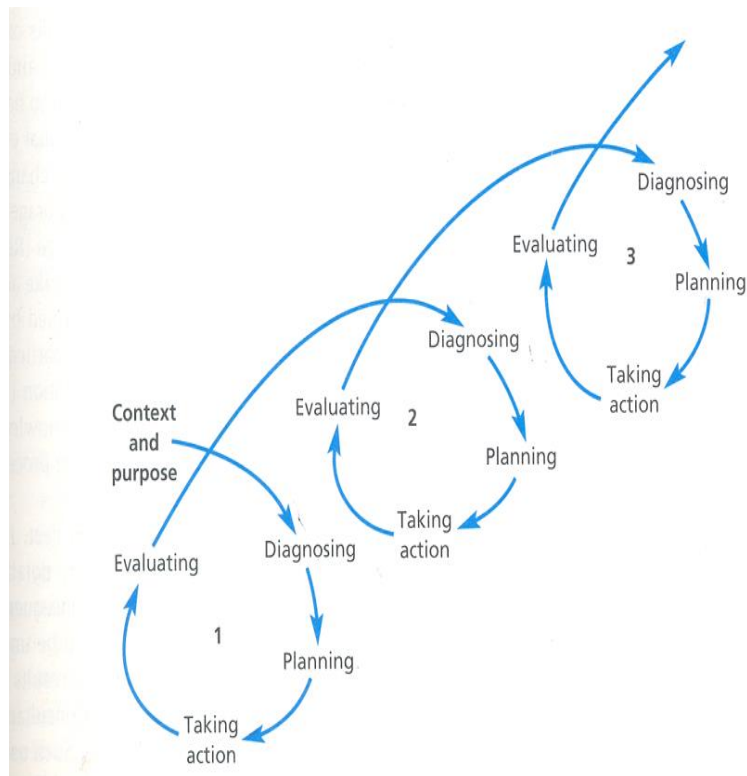


Figure 2.1 Action Research Cycles

Action Research Cycles

Diagnosing or constructing issues referred to as fact finding and analysis is undertaken to enable *action planning* and a decision about the action to be taken. These are taken (*taking action*) and the action *evaluated* (cycle 1). This evaluation in cycle 1 provides a direction for the next cycle of diagnosis, planning and action. This demonstrates the iterative nature of the process. Subsequent cycles involves further diagnosing taking into account previous evaluation , planning further actions, taking these actions and evaluating them.

Participation: This a critical component of Action Research in that this type of research is a social process in which actions researchers work with the members of an organisation or department (team of teachers), as facilitators and teachers, to

improve the situation for the participants and the department. A research can only be action research if action and participation are all present. Members of the organisation participate by being co-operative with the researchers and members of the research team participant through collaborations during the stages of the research cycles to improve the organizational or classroom practice to facilitate effective learning of chemistry. Collaboration means building a democratic approach to communication and decision making when constructing, planning, taking and evaluating each action research stage or cycle

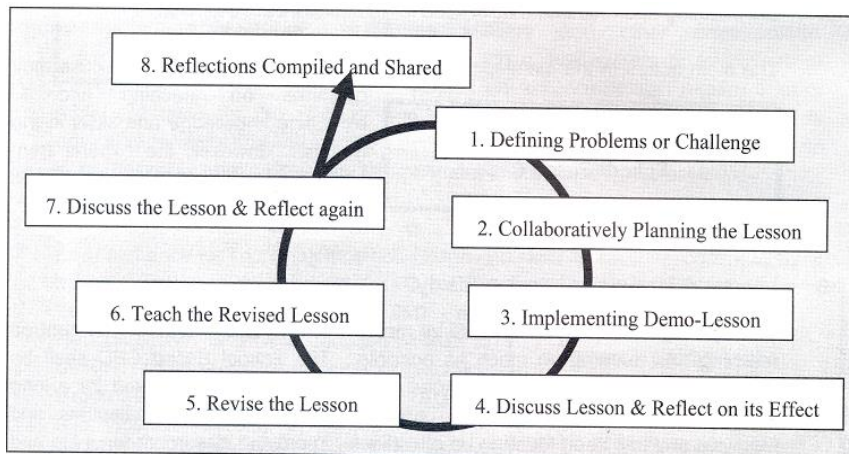
Knowledge: The nature of Action Research takes advantage of different knowledge from different sources. Action Research is not only informed by abstract theoretical knowledge, known as propositional knowledge, but also by participants' everyday live experiences (their experimental knowledge) and knowing- in- action (knowledge that comes from practical application- teaching of chemistry). These forms of knowledge will inform and incorporated into each stage or cycle of the Action Research process, encouraged by the collaborative approach that underpins this strategy.

Implication: The Action research has implications beyond the research project. Academics or teachers will use results from undertaking action research to develop theory to inform other contexts. The knowledge gained from one context can be used or to inform another context. Such use of knowledge to inform other contexts also implies to others to undertake Action Research.



ACTIVITY 2.2

Discuss the differences and similarities between action research cycles and the lesson study cycles illustrated below.



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Unit summary



Summary

In this unit we discussed what research is, classification and the types of research. **Research** is an honest, exhaustive, intelligent and systematic process of searching for facts and their meanings or implications with reference to a given problem. It is the process of arriving at dependable solutions to problems through the planned and systematic collection, analysis and interpretation of data. Research is classified in three broad categories: fundamental, applied and action research. **Fundamental research** aims at the discovery of some basic truths and laws and is not immediately concerned with direct field application. **Applied research** though very similar to action research is primarily concerned with finding results of which find direct application in the field. While **action research** is primarily conducted on the immediately available small sample in order to solve the immediate problem for the same group. Research may be either qualitative or quantitative depending on the methods used.

Action research is very important for teachers in that it improves school practice such as management and teaching and learning processes, at the same time, it develops the participants

Assessment



Assessment

1. Why is it important for you as a chemistry teacher to be involved in action research?
2. Currently the Ministry of Education has introduced new syllabuses nearly in all the subjects in secondary schools where you are teaching.
 - (a) To what extent you as a chemistry teacher have contributed to the revision of the previous curricula
 - (b) Are your decisions and actions informed by action research?
Justify your answer

Answers to Activities and Assessments

- **These have NOT been provided due to the descriptive nature of most the answers in this module**
- **If you are not sure of the answer go back and study the section of the unit where the question came from, You will definitely find the answer there.**

Readings