Initial Primary Teacher Education

Mathematics

Module 1

of

Year 1

Malawi Institute of Education

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Foreword

Education is the lifeblood of the nation. It is a prerequisite for individual, community and national development. Education prepares learners to play their roles effectively to promote and sustain a country's socio-economic development. Parents or guardians desire that their children develop into adults with sound minds and healthy bodies through the acquisition of appropriate knowledge, skills and desirable attitudes to enable them to live productive and happy lives.

Education should, therefore, help learners to develop high standards of conduct, attitudes, judgment and a sense of responsibility. Student teachers have to be well prepared in order to be able to take this responsibility of teaching children effectively.

The provision of quality education is based on many factors and a good quality of teachers is one of them. Teachers play a central role because they are the key source of knowledge, responsible for facilitating the learning process and act as role models for the learners.

The function of initial teacher education in Malawi is to prepare student teachers in their aspiration of becoming teachers of high quality. This is achieved by helping the student teachers to acquire the right knowledge, skills and competences to enable them to effectively teach children. In view of this, the Initial Primary Teacher Education curriculum has been reviewed to ensure that student teachers who graduate from this programme are well trained and prepared for their profession.

The process and implementation of this review has been guided by the Teacher Education Philosophy which states as follows:

'To produce a reflective, autonomous, lifelong learning teacher, able to display moral values and embrace learners' diversity.'

It is therefore hoped that Teacher Training Colleges will find this curriculum effective in helping the student teachers to build a solid foundation in their teaching profession.

Executive Director
Malawi Institute of Education

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UNIT 12 Teaching multiplication of whole numbers ……

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Introduction

The purpose of primary teacher education is to produce and continually develop competent and responsive teachers who effectively deliver quality education to all learners under prevailing conditions and demands in primary schools and promote their desire for life-long learning. IPTE endeavors to educate teachers in sufficient numbers, continually develop their professionalism so that they are able to effectively and efficiently deliver quality and relevant education to primary school learners.

National goals for primary teacher education

The national goals of primary teacher education in Malawi are to produce teachers who are:

- academically well-grounded and professionally competent
- flexible and capable of adapting to the changing needs and environment of the Malawian society
- capable of adhering to and maintaining the ethics of the teaching profession imaginative in adapting, creating and utilising locally available resources suitable for the needs of their learners.

Rationale

Mathematics education aims at developing student's critical awareness of mathematical concepts and their relationships and how these are used for solving practical problems in a social, environmental, cultural and economic context.

At an early stage, the learners will be able to count and carry out basic mathematical operations. At a later stage, the learners will be able to make inferences using manipulated data and to apply mathematics for solving practical problems in daily their life.

Teacher education philosophy

The following has been the guiding principle during the design, development and implementation of the IPTE curriculum.

To produce a reflective, autonomous, lifelong learning teacher, able to display moral values and embrace learners' diversity.

IPTE programme structure

The duration of the teacher education is two years. The general outlook of the two years is as follows:

Year 1			Year 2		
Term 1	**Term 2**	**Term 3**	**Term 1**	**Term 2**	**Term 3**
In college, learning subject content with a special focus on methods for lower classes	In college, learning subject content with special focus on methods for upper classes	Out in teaching practice schools, practising teaching mainly in the lower classes	Out win teaching practise schools, practising teaching mainly in the upper classes	In college, with special emphasis on reflection, inclusion and further practice on teaching methods	In college, with special emphasis on subject content, policies and frameworks

Unique features

The features of the reviewed curriculum are as follows:

- The curriculum design is based on reflective and practice principles.
- Early grade teaching methodologies are distinct.
- The delivery of the subject content follows the modular approach.
- Student teachers will be allowed to practise teaching both in the lower classes (Standards 1 to 4) as well as in upper classes (Standards 5-8).
- Cross cutting issues such as Assessment for Learning, Information Communication Technology, Inclusive Education and Critical Thinking are integrated.

IPTE subject matrix

The new curriculum has adopted the reflective practitioner model of teacher education which connects reality and theory and integrates content and pedagogy in teaching and learning. In this structure, student-teachers will be in college for terms 1 and 2 of year 1 and be in primary schools for teaching practice in the third term of year 1. Students will be back to college in terms 2 and 3 of year 2 to continue learning subject content, reflecting on their experiences during teaching practice and then wind up their studies.

This curriculum has adopted a modular design and contains eleven subjects. These are Chichewa, English, mathematics, education foundation studies, agriculture, social studies, life skills, science and technology, expressive arts, religious studies and human ecology. In this modular design, a set of units with related content forms a module in a subject. A module consists of 40 contact hours.

Although the programme is modular, four subjects: Chichewa, English, mathematics and education foundation studies will be offered throughout the two years while the remaining subjects will be spread across the two years.

IPTE outcomes based curriculum

An outcomes-based curriculum is focused on students' achievement. To achieve the outcomes, the students are introduced to new knowledge in the context of their existing knowledge so that they can develop new understandings. Therefore, the process of learning is integral to the final product. These products are the outcomes, which student teachers achieve in terms of teaching competencies and must be clearly stated before they begin teaching. The achievements made at college however will only be seen to be truly beneficial when student teachers transfer the knowledge, skills and desirable attitude beyond college and view learning as a life-long process. This is considered essential to keep pace with the transition from college to practical classroom experiences.

There is need for student teachers to acquire knowledge, skills and desirable values and attitudes to enable them to implement the primary curriculum. To that end, student teachers should be fully conversant with foundation studies and other subjects taught in schools.

Learning areas and core elements

A learning area is an organised body of the required knowledge, skills, values and desirable attitudes that serve as a foundation for future learning. Each learning area has a rationale from which core elements are derived. The IPTE curriculum comprises eleven learning areas namely agriculture, science and technology, mathematics, expressive arts, Chichewa, English, foundation studies, social studies, life skills, religious studies and human ecology. Each learning area has four or more core elements.

Teacher education core element outcomes

Teacher education core element outcomes are descriptions of the competencies to be acquired by the student teacher for successful teaching.

Progression of learning areas into subjects in the primary senior phase

Student teachers should know that during infant and junior phases, teaching and learning will centre on learning areas instead of isolated subjects. However, the curriculum will revert to subjects in the senior phase in line with the secondary school curriculum. For this reason, student teachers will study both learning areas and subjects.

IPTE assessment procedures

In Outcomes-Based Education (OBE), assessment is a significant part of the teaching and learning process. The main purpose of assessment is to facilitate learning by

constant monitoring of the progress of individual learners. The process is on-going and it uses clearly defined criteria with a variety of tools, methods and techniques in different situations and contexts. This helps to gather valid and reliable information on the learners' achievement of outcomes.

Assessment in primary teacher education in Malawi comprises two major components: continuous and summative assessment. Both modes involve assessment tasks that measure the student teachers' achievement of knowledge, skills, values and attitudes. These tasks include oral presentations, practical tasks, reports, research, tests and examinations.

In the reviewed curriculum, the weighting of continuous assessment in the final grade will be *60% continuous assessment* and *40% summative assessment.*

The continuous assessment will comprise:

- two assignments based on each module
- end of module examinations excluding terms 2 and 3 of year 2
- teaching practice grades
- school experience journal grade

While the summative assessment will comprise:

- moderated grade from teaching practice in term 1 of year 2
- national examinations to be administered in term 3 of year 2 based on the modules of terms 2 and 3 of year 2

Summary of topics for the term and time allocation

Term 1		
Topic	**Allocated time in hours**	**Core element**
Aims of teaching mathematics	2	Theories, concepts and issues in teaching and learning mathematics
Teaching for mathematical proficiency	2	
Problem solving in mathematics teaching	3	
Knowledge for teaching mathematics	3	
Issues of language, inclusion and large classes in mathematics	3	
Teaching numbers in Standards 1 to 4 Teaching	6	Number concepts and operations
Teaching place value	2	
Schemes, records of work and lesson plans	4	
Teaching equal sign	2	
Teaching addition of whole numbers	4	
Teaching subtraction of whole numbers	3	
Teaching multiplication of whole numbers	3	
Teaching division of whole numbers	3	

TOPIC 1 Aims of teaching mathematics

Time 2 hours

Introduction

Mathematics is one of the core subjects at primary and secondary school levels in Malawi. In addition, it is used in most aptitude tests.

Sometimes learners do not understand why they learn mathematics. A teacher needs to explain why each mathematical concept is important. A good understanding of the reasons why children must learn mathematics will help you make appropriate justifications for teaching each concept that is in the syllabus.

This topic focuses on importance of learning mathematics and why mathematics is core and compulsory in primary education in Malawi.

Success criteria

By the end of this topic you must be able to:

- explain why mathematics is taught in schools
- debate why mathematics is core and compulsory to all learners

Background information

We use mathematics in everyday life for various reasons; for example estimating distance, sharing things, measuring the right amount of fertilizer to apply and also comparing weather conditions.

Mathematics helps to develop reasoning skills. When children develop such skills, they will survive situations where mathematical knowledge is needed for example in business. Mathematics is also a requirement for learning science and other subject apart from being a career on its own. This means that knowledge of mathematics is considered a good foundation for children to succeed in various situations they meet as they grow up. These are some of the reasons why all learners must do mathematics.

Reasons why children should learn mathematics

Although some of the children are able to count before going to school, there is need to extend their mathematical abilities so that they can acquire as many skills as possible for use in their everyday life.

Activity 1 Discussing the uses of mathematics in everyday life

1 Reflect how you use mathematics in every day.
2 Share your ideas.
3 Discuss how learners use mathematics in everyday life.

Activity 2 Exploring reasons for teaching children mathematics

1 Analyse primary school mathematics syllabuses, teachers' guides and learners' books.
2 From your findings; what do you think are the aims for teaching mathematics?
3 Present your findings to the class.

Tip

Assign different groups to analyse materials for infant section, junior section and senior section.

Reasons for making mathematics core and compulsory

Many countries in Africa consider learning of mathematics as a must in early years of education. In Malawi, for example, mathematics is given more time on the timetable and is learnt daily at primary school level.

Activity 1 Discussing reasons why mathematics should be core and compulsory

1 Divide your class into two teams.
2 Debate on the motion; *primary school mathematics must be core and compulsory.*
3 Consolidate the ideas.

Activity 2 Introducing mathematics during your first lesson

1 Imagine you are introducing mathematics in standard 1
2 Individually, write down what you would say to learners about mathematics before introducing your topic.
3 Share your ideas.

Summary

Children should learn mathematics in the primary school because it helps in their intellectual development. In Malawi, mathematics is core and compulsory because it is considered a foundation for computation skills needed in everyday life.

Reflection and assessment

1 Why should children learn the following:
   a Profit and loss
   b Budgets and bills
   c Perimeter
2 Explain why mathematics is core and compulsory at primary school level.

Glossary

Core subject : an essential subject

Aptitude test : test given to assess if one can pursue a certain course

Compulsory : mandatory

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TOPIC 2 Teaching for mathematical proficiency

Time 3 hours

Introduction

Children need to have deep understanding of mathematics. For example, on addition of numbers; they need to understand what it means to add numbers, how to add numbers accurately and efficiently, and also the different ways of adding the numbers. Learners need to apply knowledge and skills of addition of numbers in everyday life and appreciate the importance of addition of numbers. Such understanding of mathematics is referred to as *mathematical proficiency*. In this topic, you will explore ways of teaching to promote mathematical proficiency in learners.

Success criteria

By the end of this topic, you must be able to:

- distinguish strands of mathematical proficiency
- apply all strands of mathematical proficiency to teaching school mathematics

Background information

Successful mathematics learning has taken different meanings over the years. In the 20th century alone, the understanding of successful mathematics learning has moved from emphasis on structure of mathematics and its unifying ideas to the development of "mathematical power," which involves reasoning, solving problems, connecting mathematical ideas, and communicating mathematics to others.

In the 21st century, understanding of successful mathematics learning has shifted to what is known as *mathematical proficiency.* Mathematical proficiency has five interwoven parts or strands as shown in the figure below.

Illustration showing strands of mathematical proficiency

Conceptual understanding

- This is comprehension of mathematical concepts, operations, and relations.

Procedural fluency

- Procedural fluency is the skill in carrying out procedures flexibly, accurately, efficiently, and appropriately.

Strategic competence

- This is the ability to formulate, represent, and solve mathematical problems.

Adaptive reasoning

- This is the capacity for logical thought, reflection, explanation, and justification.

Productive disposition

- This is the ability to see mathematics as meaningful and useful.

Helping children to acquire mathematical proficiency calls for teaching that addresses all the strands.

Strands of mathematical proficiency

Teaching for mathematical proficiency requires the use of a variety of resources and strategies to address learner's diversity.

Activity 1 Analysing a video lesson for strands of mathematical proficiency

1 Watch a mathematics video lesson
2 Identify the strands of mathematical proficiency that were developed in the lesson
3 What changes would you make to the lesson to improve mathematical proficiency among the learners?

Activity 2 Analysing a problem for strands of mathematical proficiency

1 Given the following problem:
½ + ⅓
2 Analyse the problem to identify strands of mathematics proficiency that would be developed as a learner solves it step by step up to a solution.
3 Consolidate your ideas.

Summary

Mathematical proficiency is a term which is used to explain knowledge, competence, expertise and problem solving skills in mathematics. The five strands of mathematical proficiency are conceptual understanding, procedural fluency, strategic competence, adaptive reasoning and productive disposition. These strands of mathematical proficiency are interdependent and should be developed together when teaching mathematics.

Reflection and assessment

1 Why is it important to teach for mathematical proficiency?
2 Learners solved the following problem; ½ ÷ ⅔. Identify strands of mathematical proficiency achieved.
3 Explain two teaching techniques that would improve mathematical proficiency in standards 1 to 4.

Glossary

Proficiency: ability
Strand: components
Computation: process of calculating
Conceptual understanding: comprehension of mathematical concepts, operations, and relations
Procedural fluency: skill in carrying out procedures flexibly, accurately, efficiently
Strategic competence: ability to formulate, represent, and solve mathematical problems
Adaptive reasoning: capacity for logical thought,

reflection, explanation, and justification

Productive disposition*:* this is the ability to see mathematics meaningful and useful

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TOPIC 3 Problem solving in mathematics teaching

Time 3 hours

Introduction

Problems can arise any time. Some of the problems that arise in our everyday life are mathematical in nature and therefore require application of mathematical knowledge and skills to solve them. It is therefore important to develop skills and techniques for dealing with problems especially those that require application of mathematics.

In this topic, you will learn the meaning of problem solving in mathematics, different strategies of problem solving and demonstrate use of problem solving as an approach to teaching mathematics.

Success criteria

By the end of this topic, you must be able to:

- apply problem solving strategies and skills to different problems
- demonstrate use of problem solving as an approach to teaching mathematics

Background information

Problem solving involves finding solutions to mathematical problems which have no clear or known procedures for solving them. These are problems that require more than applying basic computational skills. It is important to note that problem solving is not the same as solving word problems.

There are different strategies that can be used in problem solving. They include:

- *trying similar simpler examples*
- *looking for patterns*
- *guessing and checking*

The process of applying mathematical knowledge and skills to solve unfamiliar mathematical problems is known as problem solving. As teachers we need to teach mathematics in such a way that we develop problem solving skills in our learners.

Most teachers in Malawi start teaching mathematics by giving some examples often from the text books. What follows then is an exercise to check if learners are able to follow procedures. This way of teaching mathematics does not encourage logical reasoning and does not develop problem solving skills. Problem solving skills develop when learners are challenged to think mathematically and given opportunities to reason logically. Learners have to think of how to solve the problem and apply their mathematical reasoning independently.

Problem solving strategies

There are different processes of problem solving. George Polya in his book '*How to solve it'* suggests the following process of problem solving:

- *understand the problem*
- *devise a plan*
- *carry out the plan*
- *look back.*

Using the following example, can you explain the process of problem solving?

There are some ducks in a pond. Chisomo counted them and noticed that if there were seven more, there would be 100. How many ducks are there?

Firstly, you may start by understanding the problem; what information is given and what you supposed to find. Secondly, you need to devise a plan; here you need to think of different strategies you can use to find the number of ducks. For example you may guess the solution and check if it is correct. You may also come up with a linear equation like $d + 7 = 100$. Or you may try with simple similar problem and make generalisation. Thirdly you will carry out the plan and finally you need to look back if the solution is correct. In case the answer is incorrect you go through the whole process again. There are many ways of arriving at a solution to a problem. Some of these ways are explored in the activities that follow.

Activity 1 Exploring problem solving strategies

1 Given the following problem:

There are 30 teams to play against each other. Each team will play every team twice. How many matches will there be all together?

2 Individually, solve the problem using any of the problem solving strategies discussed above

3 What problem solving strategy did you use?

4 Share with your partner and the whole class

5 Discuss other problem solving strategies

TIP

Think of as many strategies as possible which learners can use to solve problems

Activity 2 Using problem solving as an approach to teaching mathematics

1 Select one topic from standards 1 to 4.

2 Discuss how you can teach it using problem solving approach

TIP

Consider the problems in the text books and see how you can change some of them into problem solving

Summary

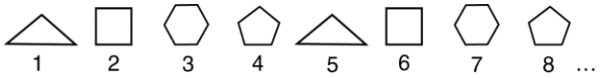
Problem solving is the process of finding solutions to unfamiliar mathematical problems. Problem solving is important because among other things, it develops logical reasoning, confidence and motivation in learners. There are different strategies that can be used to solve problems and these include; looking

for patterns, generalizing from similar simple examples and guessing and checking. As teachers we need to understand each of the different strategies to solve problems and we should anticipate as many strategies as possible from learners.

To solve a problem, one must understand the problem, devise a plan, carry out the plan and look back. This process allows checking and correcting mistakes if any.

Reflection and assessment

1 Give two reasons why problem solving approach is important in teaching mathematics.
2 Write three expected strategies you would use to solve the following; *How many 2 litre cups of water would fill a 10 litres pail?*
3 Study the shapes below.
   i What shape would be the 81st in the sequence?



   ii What strategy did you use to get the answer?

Glossary

Logic a method of human thought that involves thinking in a linear step-by-step manner

Problem an issue that has to be resolved or dealt with.

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Haylock, D (2010). *Mathematics Explained for Primary Teachers*. (4th ed). London.SAGE Publications Ltd.

Polya, G (1945). *How to solve it.* Princeton: Princeton University Press.

Schoenfeld, AH (1992). *Learning to think mathematically: Problem solving, metacognition, and sense-making in mathematics.* In D Grouws (Ed.), Handbook for Research on Mathematics Teaching and Learning (pp. 334-370). New York: MacMillan.

TOPIC 4 Knowledge for teaching mathematics

Time 2 hours

Introduction

Some people argue that anyone can teach very well as long as she or he has mastered the content to be taught. Do you agree? If yes, then think about why we have teacher training colleges? At college you will basically learn two aspects of mathematics. These are content and methodology. Under content you will be solving mathematical problems just like you did at primary and secondary school and under methodology you will learn how to teach mathematics in the primary school.

In this topic, you will learn about different types of teacher knowledge and how to apply the types in teaching mathematics. Teachers need to have different types of knowledge in order to teach effectively. In fact teacher knowledge determines the success of learning. Therefore, it is very important that you understand this topic.

Success criteria

By the end of this topic, you must be able to:

- distinguish types of knowledge for teaching
- apply pedagogical content knowledge (PCK) in teaching mathematics

Background information

Teachers need to understand the mathematics they teach. To do that, they need to have other forms of knowledge in addition to subject matter knowledge. According to Shulman (1986), knowledge for teaching is categorised into three; *subject matter knowledge, pedagogical content knowledge* and *curricular knowledge*.

Subject matter knowledge is the knowledge of the subject content. This knowledge is acquired through studying the subject. Pedagogical content knowledge is a blend of content and pedagogy that transforms the content into a form learners can understand while curricular knowledge is knowledge of the curriculum as well as a variety of instructional materials for the subject.

To teach addition of whole numbers for example, you need to know how to add whole numbers. You also need to know ways of representing the concept, examples to give, order of operation, questions to ask and the teaching and learning resources to use.

Pedagogical content knowledge (PCK) can be developed through teacher education, both during pre-service education like this programme, and during in-service courses. PCK can

also be developed through trainings, teaching experience, and teachers' own self learning such as reading academic books and articles.

Types of knowledge for teaching

Activity 1 Exploring teacher's subject matter knowledge

1 Watch a mathematics video lesson.

2 Repeat the video and assess the teacher for:
   i. subject matter knowledge
   ii. curricular knowledge *(use a 1 to 3 rating scale; 1= low, 2= average, 3= good)*

3 Compare your results with two other students.

4 Do you think you have adequate mathematical knowledge for teaching?

5 Discuss your response with other students.

Activity 2 PCK for teaching primary school mathematics

1 Observe a mathematics lesson in either standard 1, 2, 3 or 4

2 Analyse examples of PCK in the lesson

3 In groups, choose one topic and discuss the PCK needed to teach the lesson effectively.

Tips

- Make prior arrangements with the teacher you want to observe his/her lesson

Summary

There are different types of knowledge for teaching mathematics. They include *curricular knowledge, content knowledge, pedagogical knowledge* and *pedagogical content knowledge*. Pedagogical content knowledge (PCK) is the teacher knowledge for teaching and is different from knowledge of content. PCK for mathematics teaching can be developed in primary school teachers through in-service and pre-service teacher education, teaching experience, and teachers' self-learning.

Reflection and assessment

1 Explain why a teacher should be a master of subject content knowledge

2 Discuss the importance of PCK to mathematics teachers

3 Choose any topic in primary school mathematics and write down the content knowledge needed to teach the topic.

Glossary

Pedagogical content knowledge
Knowledge for teaching

References

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TOPIC 5 Issues of language, inclusion and large classes in mathematics teaching

Time: 3 hours

Introduction

In Malawi and many other developing countries, mathematics teaching and learning is affected by several factors such as language, inclusion and large classes. It is important that you understand these issues and learn how to address them. This suggests that as teachers, we have to draw more knowledge and skills and also use a variety of strategies and resources if effective teaching and learning has to take place.

In this topic, you will analyse language, inclusion and large classes in terms of their impact on teaching and learning of mathematics.

Success criteria

By the end of this topic, you must be able to:

- apply understanding of issues of language in teaching of mathematics
- apply knowledge of inclusiveness in teaching of mathematics
- apply effective ways of teaching mathematics in large classes

Background information

Teachers in countries where mother tongue language is not the language of instruction have the responsibility of ensuring that leaners are adequately supported to minimise the effect of language on the understanding of mathematical concepts. In particular mathematical terms such as fraction, percentage, proportion have to be approached in a manner that facilitates understanding of the terms. Teachers need to find ways of explaining the concepts in local languages without losing the precision of the mathematics.

Primary education in Malawi is characterised by large classes and diverse learner characteristics. This suggests that teachers have to do more to effectively facilitate learning in such classes. Characteristics of learners include fast learners, slow learners, visually impaired and those with hearing difficulties. Planning and modifying tasks to suit all learners, varying teaching methods, using a variety of resources and representations and use of specialists for special needs can address diversity related challenges among learners.

Language and teaching of mathematics

Activity 1 Analysing the effect of language on the teaching and learning of mathematics

1 Analyse how language affects teaching and learning of mathematics in standards 1 to 4

2 Discuss how you can explain the following terms in local language

without losing the mathematical meaning:
   i. sorting
   ii. classifying
   iii. matching
   iv. ordering
3 Present your ideas to the whole class

Tip
Use learners' books for standards 1 to 4 to find the appropriate words for the mathematical terms

Activity 2 Analysing a lesson for inclusiveness in teaching of mathematics

1 Watch a mathematics video lesson
2 Discuss how inclusiveness is portrayed in the lesson
3 Discuss how you would make the same lesson more inclusive.
4 Present your ideas to the whole class

TIP
Always watch the video in advance to check if all is well

Activity 3 *Exploring methods for teaching mathematics in large classes*

1 Choose one topic and discuss how you can teach it in a large class
2 Develop a lesson plan
3 Peer teach the topic
4 Evaluate the lesson with reference to language, inclusion and large class
5 Suggest how the lesson can be improved

Summary

When teaching mathematics, it is important to consider as many factors as possible. The factors include language of instruction, class size and inclusivity. By varying strategies for teaching, and also using appropriate resources for teaching and learning with a view to cater for learners' diversity, most of the issues in mathematics can be addressed.

Reflection and assessment

1 Explain how a teacher can use language properly when teaching mathematics
2 Explain three ways of having an inclusive mathematics classroom
3 Choose one topic in standard three mathematics instructional materials. Individually, write a lesson plan to demonstrate how you would teach it to a large class.

Glossary

Equity same treatment
Impairment disability

Reference

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TOPIC 6 Teaching of numbers in standards 1 to 4

Time 6 hours

Introduction

Numbers are used in our everyday life for various reasons. We use numbers to communicate extent of an event for example; 46 out of 100 have passed an examination. We also use numbers to represent quantity of materials for example; he bought 10 bananas. Learners come to school with knowledge of numbers already. For example, they understand the meaning of *two bananas*.
Understanding what learners know about numbers is important because it will help you facilitate their transition from pre-numbers to numbers.
This topic focuses on how children develop the concept of numbers from concrete to abstract. It also focuses on application of appropriate teaching and assessment methodologies when teaching numbers to standards 1 to 4.

Success criteria

By the end of this topic you must be able to:

- analyse how children develop number concepts in the early years
- apply appropriate methodologies when teaching numbers to standards 1 to 4
- use appropriate assessment methodologies when teaching numbers to standards 1 to 4

Background information

Pre-number activities are activities that children have to do before learning the concept of numbers. These activities include; sorting, classifying, matching, comparing and ordering.

Children have to *sort* objects. This involves picking similar objects from assorted group of objects. They have to *classify* objects. This involves picking out similar objects and placing them in groups. They also have to *match* objects. Matching objects involves pairing objects from two different groups. In addition, children have to *compare* objects. To compare, children observe similarities and differences between two objects. Children also have to practice *ordering* objects. During ordering, they arrange objects according to a given condition or pattern

During early stages, learners associate numbers with objects, therefore, it is important to introduce numbers by using different resources that learners are familiar with. There are different activities you can use to ensure understanding of numbers. These include the following; modelling, counting, recognising, writing and ordering.

Modelling

Modelling means the use of objects to show the meaning of numbers. To model numbers, you need to have assorted objects. For example, to model 1, you pick one object while to

model 2, you pick two objects of the same type.

Counting

Counting involves naming numbers in correct order. One can count in ascending order, descending order, and skipping. When teaching counting, it is a good idea to involve learners in pronouncing numbers correctly.

Recognising

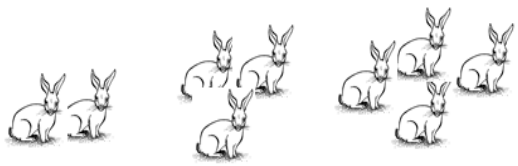
Recognising is ability to identify numbers from a mixture of several numbers.

Writing

When teaching writing of numbers the order can be; have a number card where the number is written and this to be shown to learners. After that you demonstrate how to write the number on the chalkboard. You demonstrate again how to write it in the air while facing the chalkboard and let learners practice after you. Lastly, learners practice writing the number on the ground and in their exercise books.

Ordering

Numbers can be arranged in ascending order such as 2, 3, 4 or in descending order such as 4, 3, 2. Learners need to realize that they can order objects to represent numbers as shown below.



As teachers, ensure that activities are done carefully to facilitate understanding of the activities. This helps to minimise misconceptions and errors such as writing and pronouncing numbers incorrectly.

How children develop number concepts in the early years

Children develop the concept of numbers before they start formal education. In this task you will analyze instructional materials for the teaching and learning of numbers. You will also explore how learners develop the concept of numbers

Activity 1 Analysing instructional materials for the teaching and learning of numbers

1 Analyse the standard 1 syllabus, teacher's guide and learners' book to determine the extent to which pre-activities are included.
2 Discuss how you would teach each of the following pre-number activities:
   a. sorting
   b. classifying
   c. comparing
   d. ordering
   e. matching

Activity 2 Exploring how learners develop the concept of numbers

1 Share how you learnt numbers yourself

2 Do an online search and a library research on how learners develop the concept of numbers
3 Discuss how games help learners develop the concept of numbers
4 Explain the importance of numbers in everyday life
5 Present your findings to the whole class

Appropriate methodologies when teaching numbers to Standards 1 to 4

Teaching and learning of numbers in lower classes requires use of a variety of methodologies and resources. In this task, you will explore methodologies for teaching numbers, and errors and misconceptions on numbers.

Activity 1 Exploring methodologies for teaching numbers to standards 1 to 4

1 Observe a lesson on how numbers 0 to 6 are introduced
2 Identify the methodologies and resources used in the lesson
3 Discuss how the lesson could be improved to suit diversity of learners
4 Present your ideas to the whole class

Activity2 Exploring errors and misconceptions on numbers

1 Investigate on errors and misconceptions on numbers
2 Discuss ways of addressing the errors and misconceptions
3 Share your work to the whole class

Tip

Assessment methodologies when teaching numbers to standards 1 to 4

Teaching, learning and assessment are complementary components in the teaching and learning process. In this task, you will develop assessment tools which can be used when assessing learners on pre-number activities and numbers.

Activity 1 Developing assessment tools for assessing learners on pre-number activities and numbers

1 Develop a checklist which you could use to assess learners on:
   i. pre-number activities
   ii. numbers
2 Share your work to the whole class

Summary

Pre-number activities which are taught at primary school include sorting, sorting, classifying, comparing and ordering. Number activities when introducing numbers include modeling, counting, recognising and writing. It is advisable that you modify your activities when teaching pre-number and number activities to allow all learners participate.

Reflection and assessment

1 Discuss how pre-number activities enhance learning the concept of numbers?
2 Why is it important to introduce 1, 2 and 3 before introducing zero?

3 Explain in point form how you would teach modeling 3

4 A standard 1 learner wrote 6 as ð
   a. What was the source of the error?
   b. How could you assist the learner?

Glossary

Number: quantity of objects
Numeral: a symbol used to represent a number
Misconception: misunderstanding a concept

References

Ministry of Education, Science and Technology (2010). *Initial Primary Teacher Education through Open and Distance learning Numeracy and Mathematics module 1*. Department of teacher education and development.

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TOPIC 7 Teaching place value in Standards 1 to 4

Time 6 hours

Introduction

The concept of place value is a prerequisite for most operations in mathematics. Teaching of this concept to young learners in standards 1to 4 requires use of resources such as place value boxes, place value tins, spike abacus and place value charts.
Learners must know that any number despite how large or small, can be written using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. The value of a digit depends on its place in the number. As you move from right to left in a number, the value of each place becomes 10 times greater as shown in the place value chart below:

Thousands	Hundreds	Tens	Ones
1000	100	10	1
10^3	10^2	10^1	10^0

Understanding how children develop the concept of numbers is important because it will help you in terms of preparation of activities and teaching and learning resources.
This topic focuses on how children develop the concept of place value. It also provides an opportunity for you to develop appropriate competences and assessment methodologies for teaching place value to learners in standards 1 to 4.

Success criteria

By the end of this topic you must be able to:

- explore how children develop the concept of place value
- develop competences for teaching place value
- apply appropriate assessment methodologies when teaching place value

Background information

Student teachers have the knowledge of place value of whole numbers that they learnt in primary and secondary schools. They might have used the resources of teaching place value during their learning and not teaching of place value in primary school. They are required to gain knowledge of teaching place to learners.

How children develop the concept of place value

The ideas of place values in learners are developed from learning the concept of numbers and progresses as they learn basic operations of whole numbers.
In this task, you will explore activities how children develop the concept of place value.

Activity 1 Discussing how children develop the concept of place value

1 Discuss ways how learners develop the concept of place value
2 Share your ideas to the whole class

Competences for teaching place value

Teaching and learning of place value requires use of a variety of methodologies and resources. This task focuses on methodologies for teaching place value of numbers.

Activity 1 Exploring competences for teaching place value

1 Read the activities in Teachers' guides and learners' books for Standard 1 – 4where place value box and spike abacus are used to teach place value of numbers for the first time
2 Compare and discuss the activities used in the use of place value box and that of a spike abacus in regard to:
   i. procedures to model
   ii. how convenient it is to model
3 Suggest how best to use the resources
4 Discuss how you would use other resources such as place value chart to teach place value of numbers

Activity 2 Discussing strategies for introducing place value of numbers

1 Discuss strategies for introducing place value to learners
2 Demonstrate each strategy through peer teaching
3 Discuss feasibility of each strategy with regard to large inclusive class situation

Assessment methodologies when teaching place value of numbers

Teaching, learning and assessment are complementary components in the teaching and learning process. In this task, you will develop assessment tools which can be used when assessing learners on place value of numbers.

Activity 1 Constructing assessment tools on place value of numbers

1 Construct a place value box and spike abacus
2 Demonstrate how you can use the resources when assessing learners on place value of numbers

Tip

Use numbers that are relevant to the resource constructed

Summary

Place value of a number refers to a position of a digit in a number. Place value box, place value chart, place value tin and spike abacus are some of the resources that teachers need to use to maximise understanding of the concept. Teachers are encouraged to make use of learner centred methods when teaching place value.

Reflection and assessment

1 Explain how the concept of place value can be developed from concrete to abstract
2 Suggest other ways of enhancing understanding of place value

Glossary

Place value: Position of a digit in a number

Modeling a number using objects to show the meaning of number

References

Leonard MK (1984). *Guiding children's learning of mathematics.* California: Wadsworth publishing company

Ashworth AE (1983). *The teaching of mathematics*. Kent: Hodder and Stoughton Ltd.

Malawi Institute of Education. (2008). *Numeracy and mathematics initial primary teacher education handbook*. Domasi: MIE

Malawi Institute of Education. (2007). *Numeracy and mathematics teachers' guide for standard 2*. Domasi:

Malawi Institute of Education (2009). *Numeracy and mathematics teachers' guide for standard 3.* Domasi: MIE.

Malawi Institute of Education. (1998). *Student Teachers Handbook 1 for MIITEP*. Domasi: MIE

TOPIC 8 Schemes, records of work and lesson plans

Time 4 hours

Introduction

Schemes, records of work and lesson plans were introduced in the foundation studies for you to use in all subjects. They assist in logical coverage of the work and guide a teacher not to lose focus of the syllabus. These documents provide a coherent frame work for efficient teaching and learning. This topic will assist student teachers to develop schemes of work, lesson plans and fill records of work in mathematics.

Success criteria

By the end of this topic, you must be able to:

- develop sample schemes of work for teaching mathematics.
- design sample lesson plan for teaching mathematics
- complete records of work after teaching mathematics

Activity 1 Developing schemes of work

1 Study the sample scheme of work for standard 3.

Sample schemes of work for Standard 3

Week and dates	Success criteria	Planned activities	Teaching, learning and assessment methodologies	Teaching, learning and assessment resources	References
1 5/02/18 to 9/02/18	Learners must be able to: • Add 3-digit number to 1-digit number without regrouping • Add 3-digit to 2-digit number without regrouping	**Core element:** Numbers, operations and relationships **Topic:** Addition and subtraction • Adding numbers not exceeding 99 horizontally • Adding numbers not exceeding 99 vertically • Modelling addition of a 3-digit number and 1-digit number • Modelling addition of a 1-digit number and 3-digit number • Adding 3 digit and 2 digit numbers without regrouping • Adding 2 digit and 3 digit numbers	• Group discussion • Demonstration • Question and answer • Peer assessment • Think-ink-share • KWL	• Counters (*stones sticks, leaves, seeds)* • Place value box • Spike abacus • Place value chart	Malawi Institute of Education (2008). *Mathematics teacher's guide for Standard 3.* Domasi: Malawi Institute of Education. Pages 8 – 13 Malawi Institute of Education (2008). *Mathematics learner's book for Standard 3.* Domasi: Malawi Institute of Education. Pages 41 -43

		without regrouping • Adding 3-digit number and 3 digit numbers without regrouping • Reviewing modelling addition of 2 -digit number and 3 digit number without regrouping • Reviewing modelling addition of 3-digit number and 3 digit number without regrouping			

2 Choose a topic from any lower class and prepare schemes of work for one week.
3 Share your work to the whole class.

Activity 2 Lesson plan for teaching mathematics

A lesson plan is developed from schemes of work. In this task you will develop a lesson plan. Teacher's guide and learner's book will assist you in the process of developing the lesson plan.

Activity 1 Developing lesson planning

1 Study the sample lesson plan

Standard 3

Date: 27/03/2017

Learning area: Numeracy and mathematics

Time : 7.30 – 8.05

Core element: Numbers, operations and relationships

Topic : Addition and subtraction

Success criteria

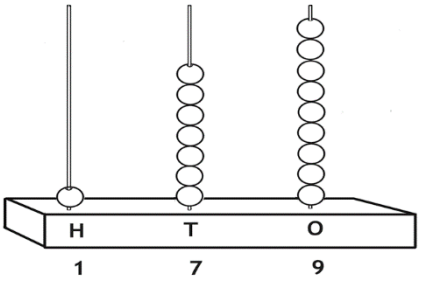
By the end of this lesson you must be able to:

- add a 3-digit number to a 1- digit number with sum not exceeding 300 without regrouping.

Teaching, learning and assessment resources

- Spike abacus, cards with mental sums

Teacher's activities	Learner's activities
Introduction (4 minutes) • Show learners the cards with mental sums of addition 21+7 = 34 +15= 17 +11= 25 +14= • Ask learners to give answers orally	• Observing • Answering orally (21+7 =29, 34+15= 49, 17 + 11= 28, 25 + 14 = 39)
Developmental steps **Step 1** (7 minutes) • Ask learners to be in groups • Distribute the spike abacuses in groups • Discuss with learners how to model 170+ 9 using a spike abacus • Model 170 + 9 with learners	• Going into groups • Receiving the resources • Discussing how to model 170 + 9 using spike abacus • Modelling 170 + 9 with the teacher using spike abacus

	
Step 2 (10 minutes) • Ask learners to model 231+ 4 using the spike abacus in their groups. • Go round the groups and assist learners • Ask learners to present their work to the class • Consolidate the work	• Modelling the problem using the spike abacus in their groups • Asking for assistance • Presenting their work • Listening attentively
Step 3 (9 minutes) • Ask learners to model 231 + 3 and 402+ 6 using spike abacus individually • Ask learners to illustrate the answer in their exercise books • Go round and mark learners work	• Modelling individually 231+ 3 and 402 + 6 • Illustrating the answer in their books • Presenting work for marking
Conclusion (5 minutes) • Go over the work together with the learners • Tell learners about the next lesson	• Going over the work with the teacher • Listening attentively

Lesson evaluation

2 Choose a lesson from schemes of work and prepare a lesson plan
3 Share your work to the whole class.

Records of work

Activity1 Designing records of work

1 Study the sample records of work

Outcomes	Remarks
Learners are able to: • Add numbers with sum not exceeding 99 vertically and horizontally e.g. 22 + 7 = 29, T O 1 5 + 7 4 8 9 • Model addition of 3 digit and 1-digit numbers on a spike abacus e.g. • Illustrate modelled addition of 3-digit and 1-digit numbers on the spike abacus (Inset a drawing of spike abacus with 213 plus 5 modelled) • Add 3-digit and 1-digit numbers without regrouping e.g. 272 + 4 = 276	The lessons were successful. Most learners did well in the tasks and the participation in the lessons was above average. There is however need to reduce number of learners in groups to increase participation. Few learners who had problems with modelling addition of numbers will be assisted during a remedial class next week on Monday.

2 Assuming you have taught all the 9 lessons on the scheme of work you prepared, complete the records of work.

3 Share your work to the whole class.

Tips

- Consider the number of periods per week to determine number of lessons
- Each bullet on the planned activities should correspond to a lesson

Summary

Schemes of work, lesson plan and records of work depend on each other. The number of periods per week determines the amount of work to be covered in that week. Each planned activity stands for a lesson. The plan developed from the activity must have correct preamble, introduction, adequate developmental steps, conclusion and lesson evaluation part. Information on how the lessons faired is then recorded in the records of work.

Reflection and assessment

1 Evaluate how lesson plans add value to the teaching of mathematics.
2 Discuss how you would fill the records of work if;
   i no single lesson was taught in that week.
   ii few lessons were not taught.
3 Write a scheme of work on any topic in Standards 1 to 4 individually.
4 Choose one activity from the schemes you have planned to write a lesson plan on it.
   a Use the lesson plan to peer teach
   b Evaluate your lesson

Glossary

Schemes of work Interpretation of the syllabus.

Lesson plan A series of teaching and learning activities that are logically arranged to assist achievement of success criteria.

Record of work A document that is used to record the extent to which success criteria have been achieved and suggestions of improving both teaching and learning.

References

Ashworth A.E. (1983). *The teaching of mathematics*. Kent: Hodder and Stoughton Ltd.

Malawi Institute of Education (2008). *Numeracy and mathematics initial primary teacher education handbook*. Domasi: MIE.

Malawi Institute of Education (2007). *Numeracy and mathematics teachers' guide for standard 2.* Domasi: MIE.

Malawi Institute of Education (2009). *Numeracy and mathematics teachers' guide for standard 3.* Domasi: MIE.

Malawi Institute of Education (2009). *Numeracy and mathematics learner's book for standard 3*. Domasi: MIE.

TOPIC 9 Teaching equal sign

Time 2 hours

Introduction

The equal sign is probably the most used notation in mathematics. In almost all branches of mathematics such as arithmetic, geometry, algebra and statistics the equal sign presents itself as a tool - a relational symbol - without which the learners' mathematical equivalence relation would be meaningless. In addition, subtraction, multiplication and division of numbers, you will use the equal sign extensively. It is therefore, important that you understand the concept of equal sign.

In this topic, you will learn about the concept of the equal sign and the different interpretations learners come to class with. You will also learn about why learners understand the equal sign the way they do, and what to do to remedy some of the misconceptions learners bring to class. A good understanding of the equal sign is a necessary precursor to a good understanding of algebra in later years.

Success criteria

By the end of this topic you must be able to:

- analyse learners' understanding of equal sign
- explore appropriate methodologies for teaching equal sign
- use appropriate assessment methodologies in the teaching and learning of equal sign

Background information on the concept of equal sign

Research has long recognised that learners tend to misunderstand the equal sign and regard it as an operator. That is, as a symbol inviting them to "do something", to "find the answer", rather than as a relational symbol signifying equivalence or quantitative sameness. Many learners usually think of the equal sign at primary and early secondary school levels as either a do-something symbol (that is, as an automatic invitation to write the answer), and/or a unidirectional symbol (that is a symbol which invites them to work out what is on the left and write the answer on the right). Such narrow understanding of the equal sign can be attributed to a number of factors:

- the use of calculators (the use of calculators has helped reinforce the idea of the equal sign as a command to carry out a calculation—for this is what a calculator does when the equal sign button is pressed)
- direct verbal to written translation of mathematical sentences (verbal expression of some mathematics problems, as in the questions: "I have 5 mangoes and I add one more. Now I have six. Then, I add again two more mangoes, which gives me eight", can not only lend to erroneous symbolization of the

equal sign but also the conception of the equal sign as a unidirectional symbol. This is so because by translating the above verbal expression into a mathematical sentence as 5 + 1 = 6 + 2 = 8, learners see the equal sign as a symbol whereby on the one side, you have what is to be computed and on the other side, what has been obtained.

- the use of metaphors to explain, for example why a + b cannot be simplified further (having recourse to the expressions involving two dissimilar objects (like "you do not add apples to bananas" is not only mathematically incorrect, but also focuses solely on procedures and not on the understanding of the implication of the equal sign)
- the use of contexts that do not denote an equivalent relation (What adds to children's misconception of the equal sign is the fact that in everyday life, learners see the equal sign used in various contexts that do not generally suggest equivalent relation but rather the *result* of something else, example:

Hard work	= success
Drink + drive	= death
Maths	= fun

- the way the equal sign is introduced to learners in early grades- it is common for the equal sign to be first introduced when learners are introduced to addition, subtraction, multiplication and division. These are operators symbols and not a relational symbol like the equal sign

Understanding the equal sign

Activity 1 Discuss situations in real life where equals is used

1 brainstorm situations where the equal sign is used

2 share you work to the whole class

Activity 2 Researching on the use of the equal sign

1 conduct an on-line search on the use of the equal sign

2 share your findings to the whole class

Exploring methodologies for teaching learners equal sign

Activity 1 Discussing strategies for teaching correct use of equal sign

1 Observe a lesson at a nearby school and discuss strategies teachers use to assist learners understand the use of equal sign.

2 Share your work to the whole class.

Activity 2 Analysing errors in using equal sign

1 Collect and analyse learners work that involve use of equal sign

2 Discuss errors learners make when using equal sign

3 Share your work to the whole class.

Ways of assessing learners on proper use of equal sign

Activity 1 Discussing ways of assessing proper use of equal sign

1 Discuss ways of assessing learners on the use of the equal sign

2 Develop a checklist for assessing use of the equal sign

Summary

The way people use the equal sign has led to several misconceptions. Some of the misconceptions arise from use of calculators, direct verbal to written translation of mathematical sentences, use of metaphors that do not denote an equivalent notation and the way the equal sign is introduced to primary school learners. Teachers are encouraged to use concrete objects when teaching concepts involving equal sign.

Reflection and assessment

1 Explore different uses of the equal sign in everyday life and discuss whether or not they are appropriate/inappropriate mathematical use of the equal sign. What conception(s) of the equal sign are these everyday use likely to develop or engender?

2 A learner writes the following mathematical sentence: 4+2=6 x 2=12-5=7. What mathematical error has the learner made? What are the possible sources of this error? How would you guide the learner to write this mathematical sentence correctly?

3 Discuss how you would know if your learners have a correct understanding of the equal sign.

Glossary

Calculator electronic	device that performs mathematical calculations
Misconception	misunderstanding
Representation	illustration

References

Carpenter, T.; M. Franke; L. Levi (2003). *Thinking Mathematically: Integrating Arithmetic and Algebra in Elementary School*. Portsmouth: Heinemann.

Falkner, K., Levi, L. & Carpenter, T. (1999). Children's Understanding of Equality: A foundation for Algebra. *Teaching Children Mathematics*, 6, 232-236).

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TOPIC 10 Teaching addition of whole numbers

Time 4 hours

Introduction

Addition is one of the four basic operations that learners learn. Adequate knowledge of addition will helps learners to understand subtraction, multiplication and division. Teaching addition of whole number requires use of varieties of teaching, learning and assessment methodologies and resources. In this topic, you will analyse how learners develop the concept of addition of whole numbers and methodologies when teaching addition of whole numbers. You will explore assessment methodologies in the teaching and learning of addition of whole numbers.

Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop the concept of addition of whole numbers.
- use appropriate methodologies when teaching addition of whole numbers.
- use appropriate assessment methodologies in the teaching and learning of addition of whole numbers.

Background information

Addition is the putting together two or more items. Addition of whole numbers involves concepts such as modelling, basic facts, properties. Learners make many errors and misconceptions when learning addition of whole numbers. Teachers are encouraged to use varieties of resources and methodologies when teaching addition of whole numbers

How children develop the concept of addition

Learners develop the idea of addition through many activities such as games even before the join formal education. We have a lot of activities in societies that involve addition e.g. growth of family as new members joins etc. This task focuses on analysing situations how learners develop the concept of addition.

Activity 1 Analysing situations where addition is used.

1 Think of situations where addition is used.
2 Generate questions that you would use to:
   a. elicit learners' prior knowledge.
   b. assist learners to appreciate importance of addition.
3 Share your work to the whole class

Methodologies when teaching addition of whole numbers.

Teaching and learning of addition of whole numbers requires use of varieties of methodologies. In this task, you will explore teaching and learning methodologies for addition of whole numbers.

Activity 1 Modelling addition of whole numbers

1 Discuss strategies for modelling addition of whole numbers.

2 Share you work to the whole class.

+		ADDEND									
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
ADDEND	**0**	0	1	2	3	4	5	6	7	8	9
	1	1	2	3	4	5	6	7	8	9	10
	2	2	3	4	5	6	7	8	9	10	11
	3	3	4	5	6	7	8	9	10	11	12
	4	4	5	6	7	8	9	10	11	12	13
	5	5	6	7	8	9	10	11	12	13	14
	6	6	7	8	9	10	11	12	13	14	15
	7	7	8	9	10	11	12	13	14	15	16
	8	8	9	10	11	12	13	14	15	16	17
	9	9	10	11	12	13	14	15	16	17	18

2 Generate and state properties of addition from the table

3 Share your work with the class

Activity 3 Exploring strategies for teaching addition of whole numbers without regrouping

1 Research on different strategies and resources you would use when teaching addition of whole numbers without regrouping

2 Explain how each strategy would be used.

3 Share and critique the planned activities

Activity 2 Discussing properties of addition of whole numbers

1 Study the addition basic fact tab

Activity 4 Exploring strategies for teaching addition of whole numbers with regrouping

1 Consider the following question$523 + 169$

2 Discuss how you can teach the question using:

i. Place value box

ii. Spike abacus

iii. Place value chart

3 Research others strategies you can use when teaching addition of whole numbers with regrouping.

4 Share to the whole class

Assessment for teaching and learning addition of whole numbers

Assessment is an integral component in the teaching and learning process. In this task, you will explore appropriate assessment methodologies in the teaching and learning of addition of whole numbers. This will help you to get necessary feedback from your learners and eventually use appropriate methodologies to support them.

Activity 1 Analysing learners' strategies when solving addition of whole numbers

1 Visit a nearby school and collect samples of learners work on addition of whole numbers in lower classes.
2 Discuss strategies learners used when solving addition
3 Present your findings.
4 Discuss the advantages and disadvantages of each strategy

Activity 2 Analysing learners' misconceptions, errors when solving addition of whole numbers

1 Using the samples collected in activity (1), analyse and identify misconceptions and errors learners have.
2 Discuss the sources and causes of such misconceptions and errors.
3 Explore different strategies how such misconceptions and errors would be reduced
4 Share with the class.

Activity 3 Discussing ways of assessing learners on addition of whole numbers

1 Explore other ways of assessing learners on addition of whole numbers apart from written work.
2 Explain how each would be used.
3 Share with the class.

Tips

- You may use the camera to capture learners work.
- Research on other sources to understand learners' misconceptions and errors

Summary

Addition basically is putting things together to get the total. The numbers that are added up are called addends. It is logical to teach learners addition without regrouping before teaching them addition with regrouping.

Reflection and assessment

1 Explain advantages and disadvantages of using spike abacus and a place value box when teaching addition of whole numbers without regrouping
2 Study the learner's solution to the given question and answer the questions that follow:

$$\begin{array}{r} 1\ \ 4\ \ 3 \\ +\quad 1\ \ 7 \\ \hline 1\ \ 5\ \ 10 \\ \hline \end{array}$$

3 Identify the error made by the learner
4 Discuss the learner's misconception
5 Discuss strategies for addressing the misconception
6 What are other misconceptions learners have in addition
7 How can you use dice to model addition of whole numbers using a place value chart?
8 Sequence the following in a logical teaching order and give reasons for doing so:
65 + 16 = ☐
102 + 384 = ☐
74 + 14 = ☐
224 + 40 = ☐

9 Why would one need the knowledge of basic facts of addition to add whole numbers of more than one digit number?
   a. Construct an assessment tool for assessing a lesson on addition of whole numbers at any level
   b. Give a detailed explanation on how best the tool can be used
   c. Discuss the advantages and disadvantages of using this particular tool.
10 Explain whether it is necessary or not to expose to learners all possible options of solving addition of whole numbers

Glossary

Basic facts of addition adding one digit number to a one digit number to get either one or double digit number

Modelling addition using objects to show the meaning of addition

Addend a number that adds to another number to get a sum (addend + addend = sum)

References

Leonard M.K. (1984). *Guiding children's learning of mathematics.* California: Wadsworth publishing company

Malawi Institute of Education (2008). *Numeracy and mathematics initial primary teacher education handbook*. Domasi: MIE.

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Max Bell etal. (1998). *Everyday mathematics student reference book*. Chicago: Everyday Learning Corporation

TOPIC 11 Teaching subtraction of whole numbers

Time: 3 hours

Introduction

Subtraction means taking away items from the given set. Learners acquire ideas of subtraction from different real life situations. Knowledge of subtraction helps learners to understand other basic operations like multiplication and division. This topic focuses on how learners develop the concept of subtraction, teaching and assessment methodologies when teaching subtraction of whole numbers

Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop the concept of subtraction of whole numbers.
- use appropriate methodologies when teaching subtraction of whole numbers.
- use appropriate assessment methodologies in the teaching and learning of subtraction of whole numbers.

Background information

Subtraction is an inverse of addition. It involves finding the missing addend, given the sum and an addend e.g. $5 + \square = 11$. Student teachers have knowledge of subtracting numbers. It accumulated over time in primary and secondary schools. They also have been exposed to different experiences of how important subtraction is in real life.

Concept of subtraction of whole numbers.

Subtraction is involved in many aspects of life. One such aspect is shopping. Money are subtracted as people do shopping.

Activity 1 Discussing how learners develop the concept of subtraction

1 Think of situations that involve 'taking away' and 'comparing'.
2 Generate questions that you would use to assist learners to appreciate importance of subtraction.
3 Share your work to the whole class.

Activity 2 Discussing the importance of subtraction

1 Discuss importance of subtraction in real life situation
2 Present your work with the whole class

Activity 1 Modelling subtraction of whole numbers

1 Discuss strategies for modelling subtraction of whole numbers.
2 Share you work to the whole class.

Activity 2 Discussing subtraction basic facts

1 Study the addition basic fact table

+		ADDEND									
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
A D D E N D	**0**	0	1	2	3	4	5	6	7	8	9
	1	1	2	3	4	5	6	7	8	9	10
	2	2	3	4	5	6	7	8	9	10	11
	3	3	4	5	6	7	8	9	10	11	12
	4	4	5	6	7	8	9	10	11	12	13
	5	5	6	7	8	9	10	11	12	13	14
	6	6	7	8	9	10	11	12	13	14	15
	7	7	8	9	10	11	12	13	14	15	16
	8	8	9	10	11	12	13	14	15	16	17
	9	9	10	11	12	13	14	15	16	17	18

2 Based on the idea that subtraction is an inverse of addition, develop subtraction basic fact table from the given addition basic fact table
3 Based on the subtraction basic fact table, generate and state properties of subtraction.
4 Share your work with the class

Activity 3 Discussing types of subtraction

1 Research on types of subtraction
2 Discuss how each is different from the other
3 Generate as many questions as you can on each type of subtraction.
4 Share your work to the whole class

Activity 4 Discussing methods of subtraction

Investigate different methods for solving subtraction of whole numbers

1 List down procedures for each method
2 Discuss advantages and disadvantages of each method
3 Demonstrate how to solve problems from learners' books (Standard 1 – 4) using the different methods

Methodologies for teaching subtraction of whole numbers

Teaching and learning of subtraction of whole numbers requires use of a variety of methodologies. In this task, you will explore teaching and learning methodologies for subtraction of whole numbers

Activity 5 Exploring strategies for teaching subtraction of whole numbers without and with regrouping

1 Using an example, discuss activities for teaching subtraction of whole numbers without regrouping and with regrouping using
   a place value box
   b spike abacus
2 Share with the whole class

Activity 6 Modifying teaching and learning activities

1 Using Teacher's guides, analyze activities for teaching subtraction of whole numbers without and with regrouping.
2 Modify selected activities to suit different learning abilities
3 Share your ideas to the whole class

Assessment for teaching and learning subtraction of whole numbers

Assessment forms the basis in the teaching and learning process. In this task, you will explore appropriate assessment methodologies in the teaching and learning of addition of whole numbers. This will help you to get necessary feedback from your learners and eventually use appropriate methodologies to support them.

Activity 1 Analysing learners' misconceptions, errors when solving subtraction of whole numbers

1 Collect samples for learners work from a nearby primary school
2 Analyse and identify misconceptions and errors learners have.
3 Discuss the sources and causes of such misconceptions and errors.
4 Explore different strategies how such misconceptions and errors would be addressed
5 Share with the class.

Activity 2 Discussing ways of assessing learners on subtraction of whole numbers

1 Explore ways of assessing learners on subtraction of whole numbers
2 Explain how each would be used.
3 Share with the class.

Summary

Subtraction is a mathematical operation which involves taking away. Basic fact of subtraction is a subtraction of a single digit number from a single or double digit number. Teachers need to use variety of teaching, learning and assessment methodologies and resources to assist learners understand the concept of subtraction.

Reflection and assessment

1 Develop activities you would use when teaching learners subtraction of whole numbers without regrouping to a large class using spike abacus.
2 Discuss ways of assessing learners when teaching subtraction of whole numbers.
3 Investigate on learners' misconceptions and errors when solving subtraction of whole numbers.
4 Explain how subtraction basic facts would be developed.
5 A learner was asked to take away 164 from 337. Write down all the subtraction basic facts used by the learner when solving the question

Glossary

Subtraction Mathematical operation involving take away or finding the difference between two sets of numbers
Subtrahend Number that is subtracted from the minuend

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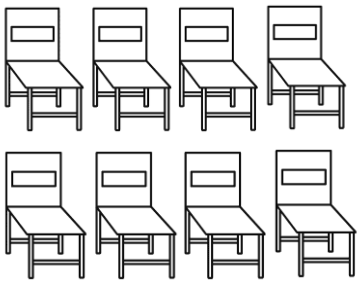
TOPIC 12 Teaching multiplication of whole numbers

Time 3 hours

Introduction

Multiplication is a binary operation which involves a multiplier and a multiplicand to give a product. 4 (multiplier) x 3 (multiplicand) =12 (product).

Children should be introduced to the idea of multiplication after they can add easily and correctly. This has to be made clear that it is a quick and convenient method of adding a series of the same number, hence repeated addition. Help learners to interpret the meaning of multiplication sentences using language of multiplication e.g. 3 sets of 4 chairs where 4 chairs is regarded as a set', '2 groups of' 5 people where one group consists of 5 people, '5 times 3 meaning that 5 has been increased 3 times.



Note that multiplication forms the building block for other mathematical concepts hence very important to make sure learners understand it well. This topic will assist students to develop concept of multiplication in learners. Student teachers will have an opportunities to practice teaching and assessing of learners using appropriate methodologies. Students will model basic facts of multiplication, explain different properties of multiplication and practice multiplying numbers with and without regrouping

Success criteria

By the end of this topic, you must be able to:

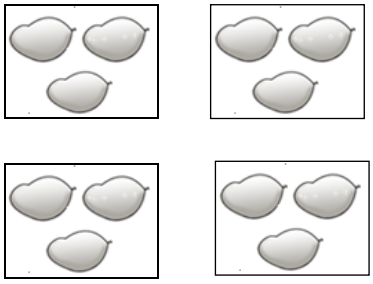
- analyse how to develop the concept of multiplication of whole numbers.
- apply appropriate methodologies when teaching multiplication of whole numbers.
- apply appropriate assessment methodologies in the teaching and learning of multiplication of whole numbers.

Background information

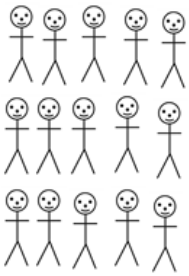
Students have the knowledge of multiplying numbers. This skill has been accumulated over the years from primary and secondary schools. The knowledge, skills and attitudes of teaching young learners is what this topic intends to impart to student teachers.

Modelling multiplication

Modelling multiplication is the use of different resources to show meaning of multiplication. Objects are put in sets/groups and the total is found by repeated addition.

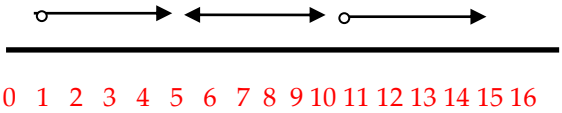


An example is having 3 groups of 5 objects where the answer shall be obtained by adding 5 repeatedly three times ie 5 + 5 + 5 = 15. Multiplication is said to be the most convenient and fast method to solve such a problem, hence 3 × 5= 15 and is interpreted as 3 groups of 5 objects to give a total of 15 objects. Objects can also be modelled using an array where objects are arranged in rows and columns



This is interpreted as 3 × 5 = 15

Number line is also another resource that can be used to model multiplication. 3 × 5 = 15 can be illustrated on a number line by 3 cut-offs of 5.



Basic facts of multiplication

Basic facts of multiplication involves multiplying one digit number and one digit number to get one or two digit number. Use of basic facts multiplication table will assist learners to interact with all the 100 basic facts of multiplication. Below is the table of multiplication facts:

Factor	Factor										
	X	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	0	0	0	0	0	0	0	0	0	0	0
	1	0	1	2	3	4	5	7	7	8	9
	2	0	2	4	6	8	10	12	14	16	18
	3	0	3	6	9	12	15	18	21	24	27
	4	0	4	8	12	16	20	24	28	32	36
	5	0	5	10	15	20	25	30	35	40	45
	6	0	6	12	18	24	30	36	42	48	54
	7	0	7	14	21	28	35	42	49	56	63
	8	0	8	16	24	32	40	48	56	64	72
	9	0	9	18	27	36	45	54	63	72	81

This table can assist learners to come up with generalizations on multiplication, hence properties of multiplication eg Zero property of multiplication where numbers multiplied by zero, the answer is zero.

Activity 1 Analysing basic facts of multiplication

1 Conduct an online research on the following:

a Properties of multiplication

b Importance of the properties when learning multiplication

c Determine the properties that are crucial in lower classes and give reasons

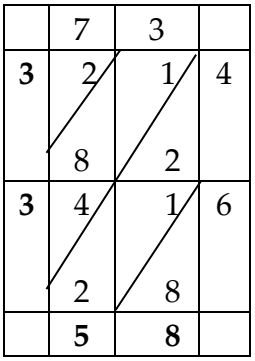
2 Suggest ways of how basic fact table of multiplication can be used

Methods of multiplication

a) Lattice method

This method involves writing factors on the outside of the lattice, thus in this case 73 and 46 multiplied are the factors being multiplied as below:

- Multiply each digit in one factor by each factor in the other factor ie. $4 \times 7 = 28$, $4 \times 3 = 12$, $6 \times 7 = 42$, $6 \times 3 = 18$,
- Add the numbers inside the lattice along each diagonal to establish the answer as 3 358



a) The traditional method

This involves multiplying each part of the first factor and the other parts of the other factor. Lastly you add the partial products e.g. $73 \times 46 = 3\,358$
$6 \times 3 = 18$, $6 \times 70 = 420$, $40 \times 3 = 120$, $40 \times 70 = 2\,800$ and then add the products to give 3 358.

These two are some of the methods of multiplication

Activity 2 Exploring methods of multiplying numbers that learners use

1 Observe learners' methods of multiplying whole numbers

2 Discuss the methods that learners use

3 Research other methods of solving multiplication of whole numbers

4 Present the methods

Activities for teaching multiplication of whole numbers

Activities that involve concrete objects would make concept of multiplication understood well with less difficulty. The activities will include writing, moulding, modelling, discussing and others.

Activity 1 Discussing activities for teaching multiplication of whole numbers

Using teachers' guides and learner's books for standard 1 to 4; analyse activities where multiplication is being taught.

1 Demonstrate each of the steps like:
   i Modelling repeated addition
   ii Introducing the multiplication sign
   iii Developing multiplication table of 2,3 4
3 Discuss other ways of introducing multiplication to learners.

Multiplication without and with regrouping

a) The concept of multiplication without regrouping must be developed from the concrete level using place value boxes and then progress to abstract level.
   Modelling of multiplication in place value box depends on repeated addition eg. 32 x 3
   - Model 32 in the place value box by placing 2 sticks in ones' column and 3 bundles of 10 sticks in tens column
   - Model the other two 32s in the same place value box using the same procedures as above.
   - Find the total in ones which is 6 and the total of bundles of 10 sticks which is 9
   - Establish the answer as 96

Activity 2 Modelling multiplication of whole numbers using a Spike abacus

1 Using Place value box and Spike abacus , discuss how 312 x 3, can be modelled
2 In groups devise and construct other simple resources that can be used to model multiplication.

Tips

- Students may be advised before the activity to work in groups to devise and construct the tool/resource that can used for modelling multiplication.
- Encourage students to be innovative and creative.

Multiplication with regrouping

Multiplication with regrouping refers to multiplication that involves transferring of numbers from one place value to another e.g. from ones to tens, tens to hundreds etc. This should be modelled using place value box first and then spike abacus before using place value chart.

Example of multiplication with regrouping using place value box:
(Take 43 × 4 = 172

- Model 43 using the place value box by placing 3 sticks in the ones column and 4 bundles of ten sticks in the Tens column
- Model another 43 in the place value box four times.

- Regroup 12 sticks in the ones column by tying ten sticks into one bundle of ten sticks
- Transfer the bundle of ten sticks to the tens column and leave 2 sticks
- Count the number of bundles of ten sticks in the Tens column plus one from the ones column
- There will be 17 bundles of ten sticks
- Regroup the 17 bundles by tying ten bundles of ten sticks and transfer the bundle to the Hundreds and leaving 7 bundles of ten sticks.
- There will be one bundle of 100 sticks in Hundreds
- Establish the answer as 172

The same procedure is followed as you model multiplication with regrouping in spike abacus,

Activity3 Modelling multiplication of whole numbers using a Spike abacus and place value box

1 Model 57 x 6 using both place value box and spike abacus.
2 Compare how regrouping is done in these two resources
3 Discuss some of the misconceptions that may arise and suggest solutions to them.

Summary

Multiplication of whole numbers involve two factors to give a product. Two ways of multiplying numbers that teachers should deliberately expose learners to are, repeated addition and equal sharing. Just like these other operations, use of objects at the earliest stage of learning multiplication is very important to facilitate learners understanding.

Reflection and assessment

1 What are the possible ways to improve transition of learning multiplication from concrete to abstract?
2 Create two success criteria of higher order when introducing multiplication to learners
3 In which class in Malawi is the concept of multiplication first introduced? Do you think it is the appropriate class? Why?
4 Why would first introduce multiplication of whole numbers using a place value box than a spike abacus?
5 Solve 2986×17= using a place value chart and identify basic facts of multiplication that have been used to solve it.

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TOPIC 13 Teaching division of whole numbers

Time 3 Hours

Introduction

Division is a common activity in life. As children handle money, share items with friends and cut food into portions, they are beginning to build up their division skills as part of their everyday life. Being introduced to these ideas at an early age will mean that as well as gaining confidence in the subject, they will be able to utilize these skills in the wider world. However, a teacher has to be very cautious when using such examples of division because the fact that these shares at times are not equal, may possibly cause confusion since division of whole numbers is based on equal sharing. It is very important that learners have enough of these practical experience which teachers should later adapt, to form basis for formal school division. Linkage to future use of division must be made clear to learners to justify their learning it e.g. Land distribution issues and division of roles. Division of whole numbers should be taught immediately after teaching of multiplication as they are inverse of each other. This topic intends to equip student teachers with the appropriate knowledge, skills and values to assist learners to fully understand division and all operations associated. It is important that hands-on practices be attended to seriously. Focus shall be on ways of dividing, types of division, basic facts of division, dividing numbers with and without regrouping and modelling division.

Success criteria

By the end of this topic, you must be able to:

- analyse how learners develop the concept of division of whole numbers.
- use appropriate methodologies when teaching division of whole numbers.
- use appropriate assessment methodologies in the teaching and learning of division of whole numbers.

Background information

Student teachers have knowledge of dividing whole numbers. They also have some practical experience of using division in real life situations. They might remember how their primary and secondary teachers taught the topic. However they don't have the expertise of teaching division to learners.

Prior knowledge on division of whole numbers

The early stages of division activities, no written symbols are used and no written work is done, but vocabulary of division has to be used orally.

(Inset a drawing of real life situation objects grouped equally eg mangoes)

Activity 1 Exploring prior knowledge on division of whole numbers

1 Discuss situations where children share things.
2 Put objects into groups of equal number of objects.
3 Emphasize words of 'equal sharing, total number of objects and objects in each group'
4 Prepare a check list you can use to assess performance of learners.
5 Share your work to the whole class

Modelling division

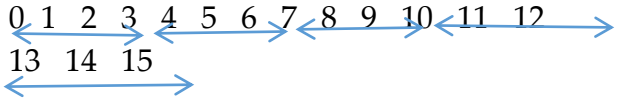
Modelling of division should start with basic facts. Thus dividing one or two digit numbers by one digit number to get one digit number. The use of objects assists learners to reconstruct these facts if forgotten. There are two ways of modelling division using objects as follows:

1 **Repeated subtraction**
This is when you have large group of objects and you subtract bits of equal number of objects one at a time until the whole group is depleted. You then count the number of groups e.g. 15 ÷ 3 =☐; you will have a large group of 15 objects and then you subtract gradually groups of 3s until the large group is depleted. The number of groups formed will be 5 in number.

2 **Equal sharing**
This is when you have a large group of objects and you intend to share it to a number of groups e.g. 15÷ 3 = ☐; you will have a large group of 15 objects and then share it to 3 learners by giving out one object at a time to each one. Lastly you count the number of objects each one receives which is 5.

By modelling the two divisions above, you will be modelling the two types of division known as measurement (equal sharing) and partitive (repeated subtraction).

Number line is also vital in modelling division of whole numbers as it assists in transition from concrete to semi-concrete level of division. The number line in division is when you draw a number line and divide it into equal cut-offs.



(Inset a number line which is 15cm long and cut-offs of 3cm long)

Activity 2 Developing division basic facts table

1 Develop division basic fact table. (Since division is an inverse of multiplication, use multiplication basic table to develop a division basic fact table)

2 Discuss how you would use it to teach basic facts of division
3 Deduce properties of division from the basic fact table
4 Consolidate your ideas

Activity 3 Practising teaching division of whole numbers

Peer teach division using number line e.g.

1 Provide strips of papers of different lengths
2 Assist learners to write a number line on them
3 Engage learners in cutting pieces of papers of equal length based on the mathematical problem
4 Discuss with learners to establish the meaning of each piece and the total number of pieces.

Tip

Encourage students to be creative and use different methods such as think-pair share, ball bearing and those that are interactive.

Teaching division of whole numbers without regrouping

Division of whole numbers without regrouping does not involve transferring of values from one place value position to another. One can use repeated subtraction or equal sharing to model it. The following is how you can model subtraction using place value box; Take 68 ÷ 2 for example.

- Put 8 sticks in the ones column of the place value box.
- Model 6 bundles of ten sticks in the tens column.
- Share 6 bundles of ten sticks to 2 learners so that each gets 3 bundles of ten sticks.
- Share again 8 sticks in the ones column to the same two learners so that each gets 3 sticks.
- Find out how many sticks altogether does each get. Each one gets 3 bundles of ten sticks and 4 sticks.
- Establish that the answer is 34.

Division on the place value charts then follows. This is where you use place value headings when doing long division.

Study the following example: 482 ÷ 2.

- You first divide 2 into 4 (Hundreds)
- Multiply 2 by 2 to get 4
- Subtract 4 from 4 to get 0
- Divide 4 into 8 to get 2 (Tens)
- Multiply 2 by 4 to get 8
- Subtract 8 from 8 to get 0
- Divide 2 into 2 to get 1 (Ones)
- Multiply 1 by 2 to get 2
- Subtract 2 from 2 to get 0
- Therefore the answer is 241

Activity 4 Practising teaching division of whole numbers

1 Demonstrate steps for teaching 84 ÷ 4 using the place value box
2 Illustrate long division of 396 by 3 using place value chart. Explain all the steps
3(a) Research some misconceptions / errors that learners make when dividing numbers Without regrouping (You can visit the nearest primary school)

(b) Suggest some solutions and present your findings.

Division of whole numbers with regrouping

If you are to teach division with regrouping, it is necessary to revise division without regrouping. The following are steps you can follow when teaching 12 ÷ 3 using place value box

- Model 12 in place value box

(Inset a drawing where 12 has been modelled in the place value box)

- Try to share 1 bundle of ten sticks to three learners. This will be impossible
- Untie the bundle and put the ten sticks in the ones column to get a total of 12 sticks.
- Share / divide the 12 sticks to 3 learners so that each gets 4 sticks
- Establish your answer as 4

Activity 4

1 Discuss how you can teach 54 ÷ 2using the place value box
2 Peer teach division of whole numbers with regrouping
3 Discuss the lesson.
4 Suggest misconceptions and solutions that may arise when learners divide numbers with regrouping.

Summary

There is need to creatively embed real life situation when introducing division to learners in the early stages of division in order to facilitate understanding of it. Teaching division using objects, place value box and spike abacus is very important. Later let learners be exposed to long division hence graduating them to abstract level.

Reflection and assessment

1 Why would subtraction be a prerequisite knowledge to the activity of sharing/division?
2 How can you assist learners discover by themselves misconceptions or errors in division?
3 Explain how you would use repeated subtraction to model 24 ÷ 6
4 Prepare a check list of concepts covered in this topic and explain how you would use it to monitor acquisition of knowledge and skills by learners.
5 Solve 784 ÷7 using long division and explain all the steps required to come up with the correct answer.

Glossary

Division is the binary operation between the dividend and the divisor to obtain the quotient.

Basic facts of division refers to one or two digit numbers divided by one digit number to get one digit number.

Partitive division is division that requires one to subtract gradually equal groups of objects from a large group to get number of groups.

Measurement division is division that will assist you to get the number of elements as you share objects into groups.

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