Course

Algebraic Modelling

MTH-2101-3

Secondary Cycle One

"Time was when all the parts of the subject were dissevered, when algebra, geometry, and arithmetic either lived apart or kept up cold relations of acquaintance confined to occasional calls upon one another; but that is now at an end; they are drawn together and are constantly becoming more and more intimately related and connected by a thousand fresh ties, and we may confidently look forward to a time when they shall form but one body with one soul."

James Joseph Sylvester

Presentation of the Course *Algebraic Modelling*

The course *Algebraic Modelling* is designed to help adult learners deal competently with real-life situations that involve solving problems pertaining to relationships between quantities.

In this way, learners become familiar with using simple algebraic models to represent relationships between quantities.

This course provides an introduction to the field of algebra. In previous mathematics courses, adults have already dealt with real-life situations involving direct and inverse proportionality, using the unit-rate method. In this course, they learn to deal with similar situations using the law of proportions (rule of three). They can also use equations to generalize and improve their understanding of common arithmetic calculations. The material covered in this course will give them the opportunity to manipulate first-degree equations with one unknown and to use simple geometric and scientific formulas. The formulas relating to perimeter, area and volume will form an integral part of this course, allowing adult learners to build on the knowledge they acquired at the Presecondary level concerning the use of geometry as a means of dealing with real-life situations. They will also learn to work with expressions containing the exponents two and three or the corresponding roots in performing sequences of arithmetic calculations and solving equations. They will thereby realize that the fields of geometry, algebra and arithmetic are indeed closely related, as the above quotation suggests.

By the end of the course, learners will be able to use algebraic language correctly, infer relationships between quantities and make deductions based on algebraic models. This will allow them to convert specific relationships into algebraic form where necessary, and to generalize an algebraic model expressing relationships that apply in different cases. They will also interpret various simple models and determine unknown values in concrete situations using models that can be written as equations with a single unknown.

Dealing With the Real-Life Situations

Dealing effectively with real-life situations is based on actions. These actions are grouped into categories and make use of a set of resources that include operational competencies and essential knowledge. During the learning process, adults are expected to construct knowledge related to these resources in order to be able to deal appropriately with their real-life situations.

The class of situations, categories of actions, operational competencies and essential knowledge constitute the compulsory elements of the course. These elements are explained in detail under their respective headings.

Class of Situations Addressed by the Course

This course addresses a single class of situations: *Establishing relationships between quantities*.

This class comprises real-life situations involving relationships between quantities that can be represented using algebraic models. It includes only situations of direct relevance to adults, with relationships that are easy to understand and that do not require complex abstract thinking. The situations must involve relationships that can be represented by first-degree equations with one unknown, or by simple, common formulas. By using equations to represent these relationships, adult learners are better able to understand them and, where necessary, to determine an unknown quantity in the situation concerned.

When purchasing an item, for example, there are relationships between total price, initial price and taxes; when checking a payslip, there are relationships between weekly salary, hourly rate and the number of hours worked; and when driving a car, there are relationships between distance, average speed and time. Simple formulas expressing relationships are also useful when determining the concentration of a domestic cleaning product, calculating energy consumption, understanding the law of levers and so on. The class also includes situations involving landscaping, renovations or construction work that require the use of geometric formulas to calculate perimeters, areas and volumes. Lastly, the law of proportions (rule of three) can also be used in situations that involve adapting recipes to a specific number of people, determining the number of people required to perform a task within the available time or calculating the quantity of water needed to dilute a product.

Class of Situations	Examples of Real-Life Situations
Establishing relationships between quantities	▪ Purchasing a commodity ▪ Leasing a commodity ▪ Subscribing to a service ▪ Conducting a sale to raise funds ▪ Exchanging currency ▪ Seeking employment based on salary ▪ Planning a meal using a recipe ▪ Consuming energy ▪ Using a lever ▪ Driving a car

Class of Situations	Examples of Real-Life Situations
	▪ Installing baseboard heaters or picture frames ▪ Installing ceramic tiles ▪ Maintaining a swimming pool ▪ Landscaping ▪ Building a stair railing ▪ Treating a lawn

Categories of Actions

The *categories of actions* are groups of actions that are appropriate for dealing with the real-life situations addressed in the course. *Examples of actions* are provided to illustrate the scope of the category in a variety of contexts.

Categories of Actions	Examples of Actions
▪ Interpreting algebraic models	▪ Uses a formula to explain the law of levers ▪ Predicts the variation in the amount of an electricity bill due to increased electricity consumption ▪ Determines the increase in volume required to dilute a solution by half ▪ Determines the relationship between the area and width of a rectangular vegetable garden
▪ Producing algebraic models	▪ Expresses the amount spent based on the initial amount and the balance ▪ Expresses the number of spindles required to build a handrail based on the distance between the spindles and the length of the handrail ▪ Expresses the number of tiles needed to cover a surface based on the area of a tile and the area of the surface to be covered ▪ Given the time required for five employees to perform a task, expresses the relationship that makes it possible to calculate the time required for two employees to perform the same task ▪ Expresses the area of a rectangular object based on its length and width ▪ Expresses the cost of renting a car based on the distance driven and the per-kilometre cost ▪ Expresses the total profit from a sale based on the number of items sold and the price of each item ▪ Expresses the distance driven during a trip based on the average speed and the time taken

Categories of Actions	Examples of Actions
▪ Determining unknown values using algebraic models	▪ Determines the quantity of items purchased from the total purchase price and the unit price ▪ Determines the hourly rate from the weekly wage and the number of hours worked ▪ Adjusts a recipe to feed a given number of people ▪ Converts an amount of Canadian currency into another currency ▪ Calculates the volume of a storage tank ▪ Calculates the area of a surface to be painted ▪ Converts degrees Celsius into degrees Fahrenheit ▪ Determines the concentration of a product ▪ Calculates the density of a material

Compulsory Elements and End-of-Course Outcomes

The compulsory elements are those that the teacher must absolutely take into account when designing learning situations.

Class of Situations

Establishing relationships between quantities

Categories of Actions

- Interpreting algebraic models
- Producing algebraic models
- Determining unknown values using algebraic models

Operational Competencies

Thinks logically

- Infers relationships between quantities
- Deduces implicit relationships between quantities in an algebraic model
- Uses proportional reasoning
- Selects the appropriate formulas and operations to calculate the value of unknown variables
- Makes sure his/her conclusions are plausible and consistent

Communicates

- Accurately decodes symbols, notations and terms related to algebraic models
- Identifies explicit relationships between different quantities
- Checks his/her interpretation with other people
- Structures the message appropriately by using algebraic models
- Rigorously uses symbols, notations and terms related to algebraic models
- Defines the variables used, so as to make the message clear and unambiguous

Essential Knowledge

- Basic algebra
- Arithmetic
- Perimeter, area, volume
- Proportion

The end-of-course outcomes describe how adults make use of the compulsory elements to deal with the real-life situations addressed in the course.

End-of-Course Outcomes
The situations in the class *Establishing relationships between quantities* involve interpreting and producing different algebraic models and using these models to determine the unknown values required to deal with real-life situations. Adult learners interpret simple algebraic models expressing relationships between quantities pertaining to different types of data (e.g. financial, scientific, measurements). To do this, they must accurately decode the symbols, notations and terms associated with algebraic models. In doing so, they recognize the meaning of the related constants, variables, exponents and coefficients. They identify the explicit relationships between different quantities in scientific and geometric formulas, and correctly deduce implicit relationships. This allows them to predict how another variable will be affected by a change in the value of a given variable or parameter in the equation. In particular, they correctly interpret the formulas for finding perimeter, area and volume. They check the plausibility and consistency of their conclusions by ensuring that the relationships they have identified reflect the principles, laws or properties with which they are familiar. If in doubt, they check their interpretation by consulting other people. Adult learners produce simple algebraic models, for example to represent the law of levers, the area of a rectangle or a weekly salary according to the number of hours worked. To do this, they correctly infer relationships between quantities in a set of similar cases. They use proportional reasoning to conclude that salaries vary according to the number of hours worked or that the time devoted to a task is inversely proportional to the number of employees involved. They rigorously use the symbols, notations and terms related to algebraic models. When communicating information involving relationships between quantities, they structure their message appropriately by using precise algebraic models. They accurately define the variables used, so as to ensure that their models are presented in a way that is clear and unambiguous for anyone examining them. Adult learners use simple algebraic models to calculate the unknown values required to address a real-life situation. In order to select the proper formula for determining the value of an unknown variable in a given situation, they compare that situation with other similar real-life situations. If they understand the chosen formula, they are able to correctly replace the variables with known values in order to obtain an equation with a single unknown. They correctly perform the necessary simplifications, algebraic manipulations and arithmetic operations on real numbers in order to accurately calculate the unknown value. They correctly apply the law of proportions (rule of three) to find the unknown value in a directly or inversely proportional relationship. They ensure that their calculations and manipulations are consistent, and that their results are plausible.

Evaluation Criteria

- Interprets algebraic models correctly
- Produces clear and unambiguous algebraic models
- Correctly determines unknown values

Operational Competencies

The contribution of each operational competency is described in terms of the actions that are appropriate for dealing with the real-life situations in this course. These operational competencies are addressed in other courses and therefore all of the courses taken together contribute to their development.

In this course, only the following operational competencies are addressed: *Thinks logically* and *Communicates.*

Contribution of the Operational Competency *Thinks logically*

The operational competency *Thinks logically* allows adult learners to make connections and draw conclusions when dealing with situations in the class *Establishing relationships between quantities*. It involves inferring relationships between quantities and making deductions based on algebraic models.

Adult learners think logically when they infer relationships between quantities by observing a set of similar cases. For example, after observing a number of rectangles, they may conjecture that the perimeter is the sum of twice the base measurement and twice the height measurement. Similarly, after taking several trips in the car, they may conclude that the distance driven is the product of the average speed and the time taken. They use proportional reasoning to conclude that salaries vary according to the number of hours worked or that the time devoted to a task is inversely proportional to the number of employees involved. They look for examples to verify their conjecture concerning the relationships they are attempting to understand, or for counterexamples to clarify, adjust or refute the resulting equation.

Adult learners deduce implicit relationships between quantities by analyzing algebraic models. For example, using the formula $A = b \times h$, they deduce that the base of a rectangle is inversely proportional to its height, provided the area remains unchanged. Among other things, this allows them to predict how another variable will be affected by a change in the value of a given variable or parameter in the equation. They make sure the relationships they have identified reflect the principles, laws and properties with which they are familiar. In order to select the formula for determining the value of an unknown variable in a real-life situation, they compare that situation with other similar situations and make deductions that will allow them to calculate the value of the unknown element. They then check the plausibility and consistency of their conclusions (e.g. calculations, inferred relationships, formulas selected).

Contribution of the Operational Competency *Communicates*

The operational competency *Communicates* allows adult learners to interpret and produce simple messages containing algebraic models when they deal with real-life situations related to the class *Establishing relationships between quantities*. It involves carefully decoding and using algebraic language.

When interpreting messages, adult learners accurately decode the symbols, notations and terms associated with algebraic models. In doing so, they recognize the meaning of the related constants, variables, exponents and coefficients. They identify the explicit relationships between different quantities in geometric formulas, especially those relating to perimeters, areas and volumes. For example, when they read the formula A = b x h, they are able to see that the area of a rectangle is the product of its base and height. Similarly, they are able to learn principles and laws from the related scientific formulas. They make sure they have correctly interpreted the information conveyed in messages containing algebraic models by consulting other people.

When producing messages, adult learners make appropriate use of algebraic language to represent relationships between quantities. They structure the message appropriately using precise algebraic models and accurately define the variables in question to ensure that the model is presented in a way that is clear and unambiguous for anyone examining it. For example, they may represent the law of levers, the area of a rectangle or a weekly salary according to the number of hours worked.

Essential Knowledge

All of the knowledge shown in the table below is compulsory since it is essential for dealing with many of the situations in the class *Establishing relationships between quantities*.

The left-hand column shows the essential knowledge that was not covered in previous courses. Where necessary, its scope is shown in parentheses. The right-hand column shows the essential knowledge that was covered in previous courses. Since previously acquired knowledge is also needed to deal with the situations examined in this course, adult learners must deepen their understanding of this knowledge by adapting it to situations involving relationships between quantities. In some cases, the knowledge outlined in this column is included with more general knowledge in the left-hand column. It is nonetheless listed in italics to make it easier to identify adult learners' previously acquired knowledge.

The formulas and equations used by adult learners should be kept fairly simple and should represent relationships between quantities that learners will encounter in everyday situations. Furthermore, it should be possible to solve these formulas and equations using basic simplification and variable isolation techniques.

New compulsory knowledge	Compulsory knowledge acquired in previous courses
Basic algebra • Variable and unknown • Constant and coefficient • Term and similar terms • Degree of an equation • Pattern and invariant • Inverse operation • Equation • Writing a simple equation with variables in order to represent relationships common to several different cases • Solving equations using algebra (using a first-degree equation with one unknown, or simple, common formulas that can be expressed as an equation with only one unknown)	**Arithmetic** • Equality

New compulsory knowledge	Compulsory knowledge acquired in previous courses
Basic algebra (cont'd) • Simplifying algebraic expressions (adding and subtracting similar terms, multiplying and dividing by a constant) • Replacing variables with known values in simple, common formulas to obtain equations with only one unknown • Testing a numerical value as a solution to an equation	
Arithmetic • Exponent • Exponential notation using exponent 2 and exponent 3 • Square root and cube root • Calculations using exponent 2 and exponent 3, and corresponding radicals • Order of operations (including radicals and exponents) • Solving sequences of arithmetic operations on rational numbers (including radicals and exponents)	• *Order of operations (the four operations and parentheses)* • *Solving sequences of arithmetic operations on rational numbers* • Making a mental estimate of the result of operations or sequences of operations on rational numbers • Representing relations using arithmetic models consisting of rational numbers • Positioning rational numbers on the number line
Perimeter, area and volume • Simple solids (cubes, cones, right prisms, right cylinders, right pyramids and spheres) • Using formulas for finding perimeter and area (circle, square, rectangle, parallelogram, triangle, rhombus, trapezoid)	**Perimeter, area and volume** • Classifying triangles and quadrilaterals • Circles • Perimeter and circumference

New compulsory knowledge	Compulsory knowledge acquired in previous courses
Perimeter, area and volume (cont'd) • Using formulas for finding volume, lateral area and total area (cube, cone, right prism, right cylinder, right pyramid and sphere) • Unit of measure of volume • Estimating volume • Converting from one measurement to another within the international system (including area and volume measurements)	**Perimeter, area and volume (cont'd)** • Area • Significant segments (side, base, height, diagonal, radius, diameter) • Units of measure of length, area and capacity • Measuring and estimating length, area and capacity • *Converting from one measurement to another within the international system (excluding area and volume measurements)* • Breaking down a complex figure into simple figures
Proportions • Proportion • Law of proportions (rule of three) • Using proportions to express proportional relations • Using the law of proportions (rule of three) to find the unknown value in a proportional relationship	**Proportional relationships** • Ratio • Directly or inversely proportional relationships

Attitudes

The following attitudes are provided as suggestions only. The development of these attitudes can help adults to become more competent in dealing with the real-life situations in this course.

Rigour	Curiosity
Adult learners with this attitude are careful about using mathematical language in accordance with codes and conventions, performing calculations or solving equations correctly, and ensuring that their results are plausible and accurate.	Adult learners with this attitude can improve their ability to identify relationships between quantities in everyday life and to devise algebraic models that accurately represent these relationships, with a view to better understanding them.

Complementary Resources

The following resources are provided as suggestions only and consist of references that may be consulted in learning situations.

Social Resources	Material Resources
▪ Different types of companies (e.g. landscape architects, car rental companies, hardware stores, electrical utilities, financial institutions) ▪ Science teachers	▪ Calculator ▪ Geometry set ▪ Measuring instruments (e.g. thermometer, balance, graduated cylinder) ▪ Algebraic tiles ▪ Software applications ▪ Internet ▪ Formulas ▪ Web sites

Contribution of the Subject Areas

The contribution of other subject areas, in particular knowledge related to the Social Sciences, Languages, and Mathematics, Science and Technology, is also useful for dealing with the real-life situations in this course. The elements identified for each subject area are not compulsory and do not constitute prerequisites.

Subject Area: Social Sciences

Program of Study: *Consumer Habits*

- Consumer-related knowledge (e.g. unit price, taxes, discounts) may be required because some of the real-life situations examined in this course involve calculating costs.

Subject Area: Languages

Program of Study: *English, Language of Instruction*

- All of the situations in this course are likely to require adult learners to communicate orally and in writing. Consequently, a knowledge of the language of instruction is required throughout the course.

Subject Area: Mathematics, Science and Technology

Program of Study: *Computer Science*

- In some of the situations in this course, adult learners may be looking for formulas on the Internet, or using spreadsheets to calculate the possible values of a variable or to produce a graphic representation of a relationship.

Programs of Study: *Technology* and *Relationship With the Environment*

- Adult learners use scientific formulas relating to technology and environment. These formulas require knowledge of various principles and laws in these two subject areas. In some cases, knowledge of the law of levers, energy consumption, watercourse flow and so on may be required.

Program of Study: *Mathematics*

- In addition to the knowledge that is compulsory for the *Algebraic Modelling* course, working with complex real-life situations may require knowledge of mathematical content covered in other courses in the Common Core Basic Education Program. This will be the case, for instance, when drawing plans or using the Pythagorean theorem to find the unknown length of a segment.

Andragogical Context

The *Algebraic Modelling* course serves as a gateway to the world of algebra. Adult learners may be somewhat apprehensive about algebra, since they may feel that the use of letters in mathematics is both abstract and inaccessible. The teacher's role is to make them realize that equations are in fact a specific and rigorous way of formulating relationships between quantities—relationships with which they may already be familiar. To do this, the teacher draws on the real-life experiences of learners. The closer the learning situations are to actual everyday situations, the more meaningful they are and the more they will help demystify algebra.

To ensure that new knowledge is built on the foundations of previously acquired knowledge, the teacher should start with real-life situations that have already been addressed using arithmetic, at least at the beginning of the course. Learners will therefore realize that they already use relationships between quantities in their financial calculations; these same relationships are now expressed algebraically. For example, learners are able to infer that the total price of a purchase is equal to the product of the unit price and the number of units purchased, plus the taxes. They can then examine other relationships between quantities, which can be easily expressed using algebraic models (e.g. the perimeter of a square, distance = speed x time). Once they are familiar with algebraic modelling of known relationships, they will be confident enough to continue their exploration of the subject by examining relationships they have not previously used, such as scientific formulas or certain geometric formulas that may be more difficult for the adults themselves to generalize.

Teachers should also remember that this course is designed to develop the operational competencies *Thinks logically* and *Communicates*. The development of these competencies allows adult learners to acquire cognitive and metacognitive strategies that can be adapted to almost every real-life situation, while requiring them to make proper use of their knowledge of algebra. Thus, learning should focus on the ability to construct and use algebraic knowledge in context, rather than on the complexities of algebra. For example, instead of focusing on the solution of equations with several terms, the teacher should ensure that learners are able to use equations or simple formulas in real-life situations when necessary. As a result, they should not only be able to use the geometric formulas that are compulsory in this course, but should also understand them and, where possible, be capable of inferring them. This course provides an excellent opportunity for learners to develop logical thinking in general, and logical inferences in particular. The formulas used are generalizations of relationships between quantities encountered in many real-life situations and cases. It will be much easier for learners to correctly use formulas in real-life situations if they are able to infer the relationships between the quantities in question, and then express them as equations with variables.

Lastly, given that algebraic models are generalizations that can be used to deal with many different real-life situations, the teacher may find it useful to devise learning situations that address several situations simultaneously. For example, the same formulas for area, perimeter and volume can be used in situations involving renovations, decorating, landscaping, maintenance, and so on. In other words, knowledge of these formulas can be acquired through a learning situation consisting of tasks that are relevant to more than one real-life situation.

Learning Situation

The learning situation that follows is provided as an example to show teachers how the principles of the education reform can be applied in the classroom.

It is authentic in the sense that it addresses a real-life situation (taken from the class of situations in the course) that adults may find themselves in. It is sufficiently open and comprehensive to allow adult learners to explore several important aspects related to dealing with this real-life situation.

The examples of actions presented in the course help the teacher to identify those actions that an adult would take to deal with the real-life situation. The teacher can then refer to these examples in order to develop pertinent learning activities.

The learning situation is organized in terms of the three steps of the teaching-learning process, which are as follows:

- planning learning
- actual learning
- integrating and reinvesting learning

These steps highlight the principles of the education reform insofar as they encourage adults to be active, to reflect on their learning and to interact with their peers when the learning context is suitable. They include learning activities and may also include evaluation activities intended to support adults in the learning process.

These activities help learners to construct knowledge related to the compulsory elements of the course that are targeted by the learning situation concerned: one or more categories of actions, essential knowledge and the actions of the operational competencies associated with the categories of actions.

The example provided also refers to certain teaching strategies—pedagogical methods and techniques—that can be selected according to the learners, the context and the learning environment. Certain learning strategies may also be suggested, as well as a variety of material and social resources.

Example of a Learning Situation

Landscape Design

The real-life situation chosen for the class *Establishing relationships between quantities* involves the production of a landscape design. In the related learning situation, adult learners are asked to think of a landscape design that they would like to produce in the near future. They prepare the design, make a list of the alterations required (e.g. a rectangular flower bed, a circular trellis, a new garden table), draw a plan (or sketch) of the design, identify the necessary formulas (some of which they already know, and others that must be inferred) and perform the calculations required to determine material quantities and project costs.

The teacher begins by ensuring that adult learners are interested in this type of project. The learning situation can be changed, for example so that it involves designing a vegetable garden or any other outdoor project, if this would be of greater interest to some learners. Although each learner may be dealing with a different project, the steps in the process are the same, and learning will be enriched through teamwork (e.g. learners help one another with their respective projects).

In the first learning activity, adult learners prepare a sketch of their design, showing all the elements they wish to include. The sketch need not be to scale, but must indicate the shapes of the various elements. Next, adult learners list all the materials and items required for the design. After taking into account the teacher's questions, they realize that the sketch does not yet provide them with the information they need to calculate precise material quantities or project costs, although they may make estimates in this regard. They must also construct new knowledge, so as to avoid unpleasant surprises during the project. To do this, they must first identify the information they need to calculate material quantities and the related costs (e.g. surface area of flower beds, volume of soil required, the number of each different variety of plant, the length of trellis or fencing, the unit prices of each item).

During the next learning activity, adult learners become familiar with the algebraic representation of the relationships involved in this situation. They begin by verbally stating the area of a rectangular or square flower bed in terms of its dimensions. Once they have expressed the area in words, they replace each word by a letter or a symbol representing an operation or equality. They work in teams to compare their resulting algebraic models, and ask the teacher to check them. They then do the same for all the shapes in their plan, inferring geometric formulas (e.g. the perimeter of a polygon, the area of a square or rectangle, the volume of a cube or rectangular prism). They note the lengths, surface areas and shapes for which they are unable to infer formulas.

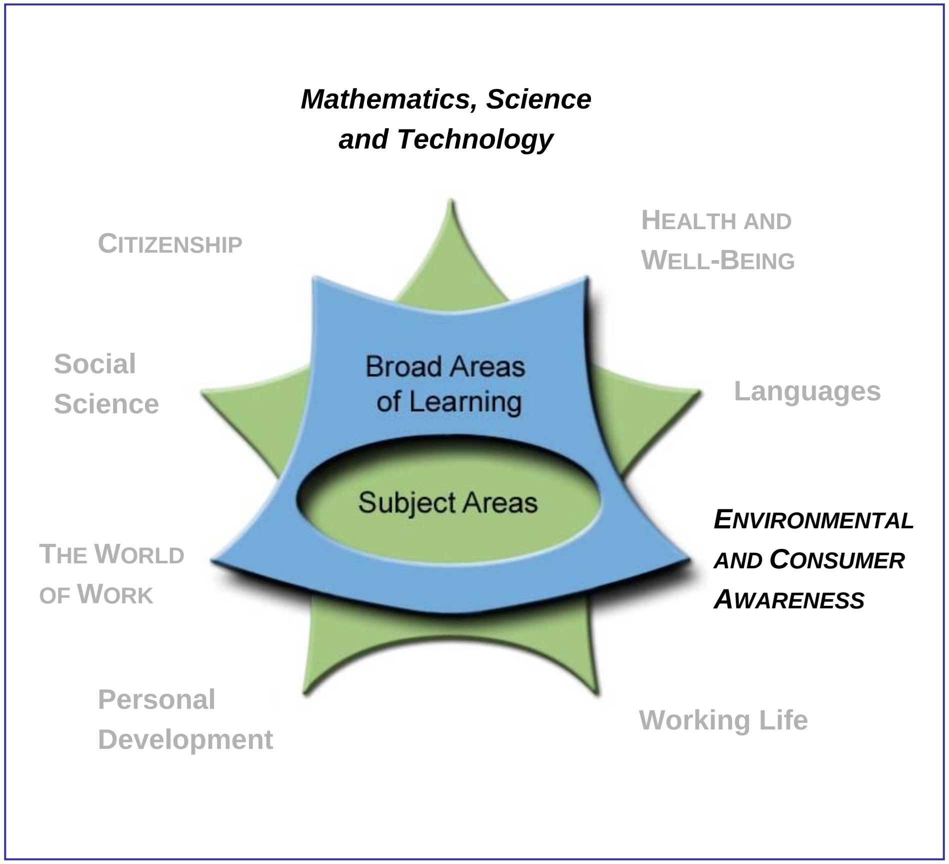
The teacher reviews the preceding learning activity with the whole class, asking the teams to share the formulas they inferred. One learner from each team is asked to explain a formula and show how it was devised. The teacher points out that inductive reasoning was used and then notes down the various lengths, areas and shapes for which learners were unable to devise formulas, indicating the objects with which they are associated. In some cases, the teacher can explain how to infer the missing formulas, for example by having learners measure the circumference and diameter of several circles and conclude that the ratio is virtually always the same. Some learners may be justifiably proud when they realize that they have discovered the constant *Pi* for themselves. For other formulas (e.g. the area of a rhombus or the volume of a cylinder), the teacher can present a proof. It is not necessary for all the formulas to be inferred or proved, because in some cases, this may require knowledge that goes well beyond the scope of this course. Adult learners will nevertheless realize that geometric formulas did not appear magically, and will be able to understand them from the teacher's presentation.

In the subsequent learning activity, adult learners perform the algebraic manipulations and the calculations required to determine the length, area and volume measurements required for their projects. Because this is not the first learning activity in the *Algebraic Modelling* course, they should already be familiar with the techniques for replacing variables with known values and calculating unknown values. They work in teams to review their results, checking with the teacher if necessary. They then determine all the costs associated with their projects by first searching the Internet for the prices of the materials and elements used. They have already learned how to perform the required calculations, either in previous courses or in their everyday lives. On the other hand, they have not yet learned how to produce algebraic models of these relationships. The learning activities used earlier to infer geometric formulas are therefore repeated, this time in order to model the relationships involved in calculating the project costs.

To conclude the learning situation, learners hand their projects in to the teacher, who evaluates them in order to support each person's learning. The teacher then conducts a class discussion during which adults are asked to name other real-life situations for which geometric formulas would be essential.

Elements of the Course Addressed by the Learning Situation

Class of Situations	
Establishing relationships between quantities	
Learning Situation	
Landscape Design	
Categories of Actions	
▪ Interpreting algebraic models ▪ Producing algebraic models ▪ Determining unknown values using algebraic models	
Operational Competencies	**Essential Knowledge**
▪ Thinks logically ▪ Communicates	▪ Simple solids ▪ Using formulas for finding perimeter and area ▪ Using formulas for finding volume, lateral area and total area ▪ Units of measure of length, area and capacity ▪ Measuring and estimating length, area and capacity ▪ Units of measure of volume ▪ Estimating volume ▪ Replacing variables with known values in simple, common formulas to obtain equations with only one unknown ▪ Exponential notation using exponent 2 and exponent 3 ▪ Square root and cube root ▪ Writing a simple equation with variables in order to represent



	relationships common to several different cases ▪ Simplifying algebraic expressions ▪ Solving equations using algebra ▪ Testing a numerical value as a solution to an equation

Complementary Resources

▪ Geometry set ▪ Measuring instruments	▪ Calculator