Course
CMP-5076-2
Introduction to 3D Modeling

Computer Science

INTRODUCTION

The goal of the *Introduction to 3D Modeling* course is to provide adult learners with the means to express their creativity and to develop skills associated with the production of 3D objects and scenes.

In this course, adult learners deal with various learning situations that help them acquire theoretical and practical knowledge about 3D modeling. They explore the environment of a 3D modeling program and make sure they understand how its tools and commands work. They imagine and model 3D objects, which they arrange in a scene, and add lights and cameras. At every step in the process, they evaluate their work by setting quality standards. They adopt ethical behaviour to communicate their ideas and respect intellectual property.

By the end of this course, adult learners will be able to create 3D scenes containing modelled and textured objects, as well as lights and cameras. They will demonstrate a sense of ethics in their communications and understand the importance of respecting intellectual property.

SUBJECT-SPECIFIC COMPETENCIES

This course targets the following subject-specific competencies:
- *Interacts in a computer environment*
- *Produces computerized documents*
- *Adopts behaviours that reflect a concern for ethics, safety and critical thinking*

Thus, it is by activating and integrating all three subject-specific competencies and by using other resources that adults are able to effectively structure their learning.

During the learning situations, adult learners communicate using a human-machine interface and evaluate their efficiency in using a computer environment. They carefully plan their work and adapt their plan as they work. As they carry out a project and upon its completion, they evaluate their efficiency and make any necessary adjustments, while adopting ethical behaviour.

PROCESSES AND STRATEGIES

As they learn about computers, adult learners are called upon to use various processes and strategies. These processes and strategies represent the way in which adults go about solving problems, meeting challenges and, in general, carrying out their learning activities.

For the *Introduction to 3D Modeling* course, the suggested approach is the production process.

Production process
• This process consists of two steps: planning and production. Four values are associated with it: communicate clearly; validate the production on a regular basis; maintain ongoing feedback and collaboration; accept the change. • During the planning stage, adult learners must define the work to be done as precisely as possible. Planning must be flexible and allow adjustments throughout the project. • During the production stage, adult learners must complete the project according to the planning established; maintain ongoing feedback and collaboration; accept change, even at the end of the production stage, and respond to change rather than following the initial plan.

Examples of strategies	- Comparing the current situation with the desired situation - Determining the steps involved in carrying out the work - Drawing up a work schedule - Choosing a work method - Making adjustments to the plan as they work - Analyzing their results

To meet the requirements of the production process, the initial plan must be flexible enough to allow for adjustments throughout the project. Through discussions with the teacher or with their peers, adults learn to reflect on each step in their process and arrive at a result that will differ from their original plan. By applying the above process, they learn to cooperate with others and to accept changes during the course of a project.

CROSS-CURRICULAR COMPETENCIES

The cross-curricular competencies are not developed in a vacuum; they are rooted in learning situations and contribute, to varying degrees, to the development of the subject-specific competencies, and vice versa.

Several cross-curricular competencies can be useful in dealing with the learning situations in the *Introduction to 3D Modeling* course. Two are considered particularly relevant to this course: *Uses creativity* and *Adopts effective work methods.*

▪ **Intellectual Competency**

When adult learners work on a 3D modeling project, they learn to *use creativity*. When they model 3D objects or prepare a scene, they create a virtual world that reflects their vision of a real or imaginary world.

▪ **Methodological Competency**

Working on a 3D modeling project requires sound planning. There are many steps involved, adults must constantly reflect on their approach and make corrections before moving on to the next step. Thus, at each step in their project, they immerse themselves in a context or intention

and engage in their work while adopting a flexible approach. This enables them to develop the competency *Adopts effective work methods.*

SUBJECT-SPECIFIC CONTENT

The subject-specific content consists of knowledge and cultural references. The prescribed content for this course is outlined below. However, depending on the context (e.g. if certain tools or functions are not available in a given software program), other equivalent content may be substituted for that outlined below.

KNOWLEDGE

- ***3D environment***
  - Spatial representation on a coordinate system with three axes
  - Display modes (wireframe, solid, texture) and work modes (orthographic and perspective projections)
  - Texture mapping
  - Lights
  - Cameras
  - Renders
- ***Object components (vertex, edge, polygon, texture)***
- ***Modeling techniques***
- ***Rules of scene composition***
- ***Standard terminology associated with 3D modeling***
- ***Modeling 3D objects***
  - Using the polygonal modeling technique
  - Using the Bézier curve modeling technique
  - Using modeling tools
    - Extrusion
    - Boolean operators
    - Revolution
  - Editing text
    - Modifying attributes (e.g. font, font size)
    - Applying textures or materials
    - Deforming text

- **Creating and applying textures or materials to objects**
  - Creating basic materials
  - Modifying the properties of materials and textures
    - Transparency
    - Shading
    - Reflection (mirror effect)
    - Positioning bitmap images over 3D objects (mapping)
  - Combining materials
- **Adding and modifying lights**
- **Adding and modifying cameras**
- **Importing objects**
- **Producing renders of varying qualities**
  - Image
  - Video
  - Printing

CULTURAL REFERENCES

The following cultural references will help adults understand some of the factors that influenced the development of computer science. These references give a cultural dimension to instruction, expand the adult learners' knowledge and make their learning meaningful. The teacher, with input from adult learners, may choose other references that are more appropriate to the task at hand.

- **Events and chronology**
  - Video games
  - Computer simulation
  - Films on virtual reality
  - Special effects in film productions
  - History of sculpture
- **Heritage objects**
  - 3D photography: from stereoscopy to polarizing filters
  - 3D modeling peripherals
  - Storyboards (sketches for films using special effects or 3D animation)
  - Video game or film action figures

Diversified Basic Education Program: *Computer Science*

■   ***Regional or national references***

- Video game designers, film producers, advertising and marketing firms, digital artists
- Anecdotes
- School-related elements

FAMILIES OF LEARNING SITUATIONS

The goal of the *Introduction to 3D Modeling* course is to provide adult learners with the means to express their creativity and to develop their skills in the production of 3D objects and scenes. This course gives adult learners the opportunity to perform actions that will enable them to interact in a computer environment, produce quality computerized documents and adopt ethical behaviours.

The shaded cells in the table below provide specifics about the contexts in which the prescribed families of learning situations are applied in this course.

Subject-specific competencies	Families of learning situations related to . . .		
	Information	**Creation**	**Critical thinking**
Interacts in a computer environment	Interacts by interpreting signals he/she receives and using input and output peripherals	Discovers what computers can do by consulting documentation and by experimenting	Critically examines computerized communication tools by applying evaluation criteria
Produces computerized documents	Communicates by using computerized services	Creates by correctly using the appropriate functions	Evaluates his/her work by setting quality standards
Adopts behaviours that reflect a concern for ethics, safety and critical thinking	Communicates respectfully, using the conventions of a given medium	Acts prudently by adopting safe behaviours	Validates information by using validation criteria

First, adult learners discover what computers can do by consulting documentation and by experimenting. For example, they may determine what is feasible or choose the right tool to carry out a project.

Then, adult learners create documents by correctly using the appropriate functions and thus work more efficiently. They evaluate their work on a regular basis by setting quality standards or by taking into account standards that have been set for them. Throughout their project, they communicate respectfully, using the conventions of a given medium.

BROAD AREAS OF LEARNING

The broad areas of learning deal with major contemporary issues. Ideally, the situations to be studied should be selected in keeping with the educational aims of the broad areas of learning, since these areas of learning provide a broader context for the learning situations and thus serve to make learning more meaningful. Two broad areas of learning are considered particularly relevant to this course: Health and Well-Being, and Career Planning and Entrepreneurship.

▪ **Health and Well-Being**

Helping adult learners understand the importance of healthy living habits is an essential aspect of the Computer Science program. Thus, a learning situation that helps make adult learners aware of how virtual reality affects health and well-being meets the educational aim of the BAL Health and Well-Being.

▪ **Career Planning and Entrepreneurship**

By developing computer competencies, adult learners increase their overall employability. A learning situation that introduces adult learners to the creation of three-dimensional scenes for the movie or video game industry meets the educational aim of the BAL Career Planning and Entrepreneurship.

EXAMPLE OF A LEARNING SITUATION

All learning situations, no matter what broad area of learning is targeted, place adult learners at the heart of the action. Learning situations promote the development of subject-specific and cross-curricular competencies, the acquisition of computer knowledge and skills and the mobilization of various resources that are useful in carrying out the tasks at hand.

The table below shows the elements that need to be considered when developing a learning situation and highlights those selected for the learning activity described on the following page.

ELEMENTS REQUIRED IN LEARNING SITUATIONS	
Broad area of learning (targeted) - Contextualizes learning to make learning more meaningful	• Career Planning and Entrepreneurship
Subject-specific competencies (prescribed) - Are developed in action and require the active participation of adult learners	• Interacts in a computer environment • Produces computerized documents • Adopts behaviours that reflect a concern for ethics, safety and critical thinking

Family of learning situations (prescribed)
- Group together situations appropriate to the course, based on issues drawn from reality
- Promote the acquisition of computer knowledge and skills
	• **Information**
	  o Communicates respectfully, using the conventions of a given medium
	• **Creation**
	  o Discovers what computers can do by consulting documentation and by experimenting
	  o Creates by correctly using the appropriate functions
	• **Critical thinking**
	  o Evaluates his/her work by setting quality standards

Cross-curricular competencies (targeted) - Are developed in context together with the subject-specific competencies	• Uses creativity • Adopts effective work methods
Knowledge (prescribed) - Includes computer knowledge and skills that adult learners must acquire in the course	• 3D environment • Object components • Modeling 3D objects • Creating and applying textures or materials to objects • Texturing 3D objects • Adding and modifying lights and cameras

This section provides an example of a learning activity. It includes a context that serves as a common thread throughout the activity; however, it is not formally spelled out. Although they may not be explicit, the learning situation includes the elements identified in the table above: the broad area of learning, the subject-specific competencies, the families of learning situations, the cross-curricular competencies and the prescribed knowledge. To promote learning, these elements must be structured in a coherent and meaningful way.

Teachers can target any element as a focus of learning, be it actions related to the subject-specific or the cross-curricular competencies or the prescribed knowledge that adults must acquire.

3D model of a laptop

Task: Create a 3D model of a laptop.

The teacher asks adult learners to create a 3D model of a laptop, which they can then integrate into a 3D scene containing a background and various objects such as a workstation and chair. This will allow them to demonstrate their knowledge of work methods associated with certain contexts.

To prepare for the task, adult learners are asked to draw a sketch of a laptop and to plan the steps involved in the project. Once the project is completed, the adult learners present it in the medium of their choice.

To carry out the activity, adult learners will use a popular modeling technique: polygonal or Bézier modeling. They will apply to their object textures created by them based on photos or images culled from the Web.

They are not expected to master all of the course content before they begin their project; rather, they will construct their knowledge as they work, using the means at their disposal: the documentation provided, planning, communication with peers (when the situation permits), and reflection and review. They will plan their work in advance and, in collaboration with the teacher or their peers, will analyze their results at each step, regulating their approach in accordance with their needs.

END-OF-COURSE OUTCOMES

We perceive the world around us in terms of three dimensions: length, width and depth. The *Introduction to 3D Modeling* course gives adult learners the opportunity to better understand this representation of the universe through the creation, modification and manipulation of three-dimensional objects.

When adult learners *discover what computers can do*, they consult available software documentation, tutorials and guides. They search the Internet for information that may help them. They look for inspiration in available creations in order to design an original product.

When adult learners *create*, they consider all aspects of the task at hand and plan their work using sketches to determine the desired result. They determine the resources to use, break the work down into steps and draw up a work schedule. They choose a work method that is appropriate for their project. At each step in their project, they analyze their results in order to determine the improvements to be made and the means of doing so.

When adult learners *model* 3D objects, they use libraries to store and retrieve the objects they draw or import; they modify the properties of the objects and group them, if necessary. They use

the most common modeling techniques, namely polygonal and Bézier modeling. They use such modeling tools as extrusion, Boolean operators and revolution. They edit text and change attributes; they apply textures or materials to the objects they model.

When adult learners *design* a scene, they arrange objects harmoniously within it while respecting the rules of spatial perception. They add lighting to bring light and shadow into their scene and integrate cameras to produce various points of view. If necessary, they use layers to distribute the objects in the scene and make it easier to manipulate them.

When adult learners *evaluate their work*, they record their observations and establish quality standards that they will be able to use in subsequent work.

When adult learners *communicate*, they demonstrate their sense of ethics and act responsibly by respecting the copyright of the digital material they use.

Throughout the learning process, adult learners develop competence in the following computer knowledge and skills: they create 3D models of objects and arrange them in a scene, to which they add lights and cameras. In addition, they do not hesitate to consult various resources to obtain help when difficulties arise.

EVALUATION CRITERIA

Interacts in a computer environment

- Use of appropriate strategies to interact and to troubleshoot

Produces computerized documents

- Thorough planning of the work

- Appropriate formatting based on document type

- Application of appropriate tools and functions

- Rigorous compliance with the constraints identified

Adopts behaviours that reflect a concern for ethics, safety and critical thinking

- Adequate communication using the conventions of a given medium