Learning Objects Design and Development – Best Practices

By

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Abstract

The term *on-line learning* has become something of an all-inclusive phrase in today's educational vocabulary. The term is generally used to describe those educational technologies that electronically or technologically support both learning and teaching. A mindful approach to developing curriculum utilizing on-line technologies should be a priority when designing and developing courses for this type of delivery. Whether incorporating learning objects into an on-line course or simply providing text based modules, utilizing high quality, relevant, engaging content has to be one of the key base components for successful on-line learning. This will be a crucial factor in creating engaging, meaningful experiences for the student.

This *instructional primer* is primarily intended to provide research behind developing learning objects for on-line delivery. The intention is to have it used as a *best practice* and *guideline tool* for instructors facilitating and developing on-line curriculum.

Key words: on-line, learning object, curriculum, critical thinking, instructional design, media, multimedia, communication, learning, development, design.

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Learning Paradigms Applied to On-line Delivery and Learning Objects

The term *on-line learning* has become something of an all-inclusive phrase in today's educational vocabulary. The term is generally used to describe those educational technologies that electronically or technologically support both learning and teaching. Increasingly, post-secondary institutions are placing an emphasis upon on-line delivery models for their students. As a direct result of the tough economic situation that post-secondary institutes are facing over the next decade, many are looking towards on-line delivery as a way to increase revenue and create more economic stability for themselves. However, simply transferring traditional face-to-face curriculum via on-line technology is no guarantee of success. A mindful approach to developing curriculum utilizing on-line technologies should be a priority when designing and developing courses for this type of delivery. Whether incorporating learning objects into an on-line course or simply providing text based modules, utilizing high quality, relevant, engaging content has to be one of the key base components for successful on-line learning. This will be a crucial factor in creating engaging, meaningful experiences for the student.

Developing critical thinking through meaningful learning connects concepts and ideas together, allowing for a deeper synthesis of knowledge. Numerous learning theories have studied the ways and techniques whereby individual students analyze and expand meaningful learning through critical thought. "This view is related to an increased emphasis on meaningful learning. Meaningful learning, in contrast to rote or superficial learning, refers to the idea that new information is solidly anchored in the learner's knowledge base and is enriched with causal relations, abstractions, and elaborations" (Eysink, de Jong, 2009, p. 584). When designing curriculum for face-to-

face classroom instruction, established methodologies can often be implemented into the design. To design the same curriculum for on-line delivery, different approaches likely will have to be applied. One critical aspect that needs to be taken into account is appropriately using on-line technologies (learning objects) within the curriculum to help create engaging and meaningful learning. Using the best tool for the task at hand is a key element when developing learning objects. "Web 2.0 technologies encourage artistic expression and sharing of personal feelings and ideas through a wide range of digital media. The democratization and decentralization of knowledge enabled by the participatory Web may foster habits of mind that are conducive to creative and new ideas, enjoyment of dialogue and collaboration, self-efficacy in creative work, sensible risk taking, and so forth" (Zhang, 2009, p. 275).

Researchers continue to study the design and dissemination of curriculum for on-line delivery that creates not only engagement, but also establishes connections to concepts, resulting in meaningful learning. "The revised Taxonomy [Remember, Understand, Apply, Analyze, Evaluate and Create] is based on a broader vision of learning that includes not only acquiring knowledge but also being able to use knowledge in a variety of new situations" (Mayer, 2202, p. 226). Meaningful learning and/or critical thought can be attained using today's technologies, but more care in the initial design phase and development of content needs to be considered. "Retention requires that students remember what they have learned, whereas transfer requires students not only to remember but also to make sense of and be able to use what they have learned" (Mayer, 2202, p. 226).

Currently there are still researchers in the learning methodologies field who argue the use of learning objects and technologies does not significantly improve meaningful learning for the student. These researchers maintain there are still learning situations that only require the data to be memorized, and this rote memorization is sufficient for the task at hand. In some cases, students only need to recall simple facts using traditional mediums such as paper and pen. These memorized facts, such as recalling the periodic table of elements for chemistry or mathematical formulas for calculus, can then be applied to other concepts, allowing for greater connections to be developed in the future. "Over the last two decades there has been a worldwide investment in educational technology based on the assertion that technology can help students learn more effectively, which would then lead to higher academic achievement, but little empirical evidence supports this claim" (Baskerville, 2012, p. 120). Many times simply memorizing data suffices for the situation at hand or even be applied to a future problem. Many of today's curriculum designs tend to have the desired goal to implement all aspects of the revised taxonomy while the curriculum does not warrant this approach. Richard Mayer (2002) shares this same goal when he wrote, "the revised Taxonomy is intended to help broaden the typical set of educational objectives to include those aimed at promoting transfer" (226). The educational designer must ask: are on-line delivery methods using learning objects achieving the desired objective? The debate over the use on-line delivery technologies versus traditional learning models may never be fully answered. Regardless, there is general agreement that more care and attention to the development and design phase of learning objects needs to be a priority. The over-arching goal is for the student to be successful, and that requires them to be actively

engaged in their learning. The actual delivery method is secondary.

Various models of learning theories have been developed and refined over the years, making them beneficial for the design and development of on-line delivery and learning objects. Some of the more popular theories in use today include: Action Learning theory, Cognitive Load theory and Constructivist theory. Below are short descriptions of these theories core concepts.

Learning Theories

- ***Action Learning Theory***

  Action learning theory is "process-oriented, systematic, reflective, and geared towards improvement" (Rand, 2013, p. 231). This theory postulates that individuals learn by actually working through a real life situation and reflecting upon the results. It is more about applying the knowledge through practice, and learning from the process, whereby the student will improve future performances. Simply stated; real learning is based on real-life experiences. Action learning uses the think/act/reflect model, which is integral to providing students with both the theoretical and practical skills they will need in life. On-line learning and the use of learning objects in the curriculum allows for this *real life* situation to be practiced. Learning objects that utilize simulations allow for students to learn the equipment and/or the process before actually working on the equipment in a real world situation.

- ***Cognitive Load Theory***

  Cognitive load theory is a "framework of instructional design principles based on the characteristics and relations between the structures that constitute

human cognitive architecture, particularly working memory and long-term memory" (Wong, Leahy, Marcus, Sweller, 2012, p. 449). This theory contends that the amount of information a learner can process in their working memory is finite. Overloading working memory can result in information not being processed effectively and results in poor long-term memory recall. Information must not only be processed, but also retained by an individual in order for additional connections to be made and meaningful learning to take place. Learning objects can be designed to utilize audio and animations that may improve the cognitive learning of a student. These learning objects allow a student the opportunity to review content at a later time. More information can be received and recalled for future use.

- ***Constructivist Theory***

  In the constructivist learning approach, learners bring unique prior knowledge and beliefs to a problem. "Knowledge is constructed uniquely and individually, in multiple ways, using a variety of tools, resources, and contexts" (Paily, 2013, 39). Constructivist theory implies that learning is both an active and reflective process. Learning results from social interaction and collaboration between the student and the teacher, resulting in meaningful learning. "Activities, opportunities, tools and environments are provided to encourage meta-cognition, self-analysis -regulation, -reflection and -awareness" (Paily, 2013, 39). By designing real-world examples for the students and creating an environment of collaboration and exploration, the teacher facilitates and guides the knowledge construction for each student,

resulting in more meaningful learning. Numerous educational theorists believe on-line delivery for curriculum is an ideal environment for the acquisition and construction of knowledge through interaction in a social environment. "They [students] provide a sensible framework for understanding and describing phenomena which fit with the learner's experience; new information is integrated with existing beliefs and ideas about how the world works" (Hennessy, 1993, p. 7). Developing on-line asynchronous discussions and/or forums can facilitate and develop an on-line environment where ideas and experiences are shared among students.

Defining Key Terms

- ***Critical Thinking***

  Critical thinking is a higher order of thinking: it is an effective method of teaching skills and evaluating outcomes. Critical thinking focuses on the comprehension and interpretation of data: it involves using creative activities to formulate hypotheses and evaluate arguments. Critical thinking considers relevant factors, criteria and values before rendering a judgment of a situation. Examples of situations requiring critical thinking would include self-reflective activities, self/peer assessments or problem solving activities.

- ***Design***

  In the context of this paper, design will refer to both instructional design and graphic design.

Instructional Design:

Instructional Design (ID) is the creation of a plan or convention for the construction of an object or a system. ID intends to accomplish goals in a particular environment within the constraints of the environment. Instructional Design considers the aesthetic, functional, interactive and connections between concepts. Successful examples of ID provide a roadmap or an approach for someone to achieve a unique expectation. The design will provide clear specifications, parameters, and activities to achieve the objective.

Graphical Design:

Directly linked to instructional design is the graphical design of any learning object. The aesthetic layout and appearance of a learning object works directly in coordination with the instructional design. A successful graphical design incorporates proven techniques using colour, typography, images, and general layout that translates into a successful student experience.

- ***Learning Objects***

  Usually digital in form, learning objects combine various mediums to create new media pieces that educate students about a concept, information or ideas. Examples of learning objects are on-line videos, presentations that incorporate animations and audio, and interactive media pieces that test the student's skills and understanding. Tools such as Flash, PowerPoint, Articulate and video games are all used to create learning objects for students.

- ***Medium***

  Storage and/or transmission tools used to store and deliver information or data. For example: television, radio, and newspapers.

- ***Media***

  Media can be content in both digital and analog form and in many cases combines more than one medium. Often considered to be synonymous with mass media or news media, but for the purpose of this report will refer to any means of information communication.

- ***New Media***

  Media technologies that allow for manipulation and interactivity and are typically found on the Internet. New media can be in the form of video games, videos, animations, or presentations. New media combines traditional media, which is usually considered passive, and adds interactivity, making it more of a collaborative medium between user and object. Video games are a good example of interactive new media objects.

- ***On-line Communities***

  Sometimes referred to as digital tribes, on-line communities are communities of like-minded individuals who come together for a common interest or reason. Examples of these environments include blogs, wikis, forums, user groups, or social media (Facebook, Instagram, Pinterest, etc.).

- ***Pedagogy***

  Pedagogy is derived from the word paidagogos, which is Greek for *teacher of children*. Many define pedagogy as the art and science of teaching and

educational strategies. Pedagogy facilitates the acquisition of new knowledge, beliefs and/or skills for the student and provides the strategies of instruction. Examples of pedagogical methods include assessments, visualizations, field-based and classroom based labs, problem solving, classroom and on-line discussions or demonstrations.

- ***Taxonomy***

  In general, taxonomy is the practice and study of classification of things or concepts, as well as the principles that underline such classification. As a scheme of classification, taxonomy can be used to place concepts or ideas into ordered groups or categories.

  An educational example would be *Bloom's Taxonomy*, a classification system used to define and distinguish levels of educational objectives – cognitive, affective and psychomotor.

Communication Theories

Communicating a message using imagery, video, animations, and audio (to name a few) can inadvertently change the meaning and learning for the student, depending on how the media is used. The curriculum designer therefore, must be ever mindful about how students learn. When developing on-line curriculum, incorporating communication theories provides a conceptual framework that can be integrated into the design and development of learning objects. Media Ecology theory and Agenda Setting theory both study the effects of media; the framing of ideas and the environment media indirectly creates when communicating messages.

- ***Media Ecology Theory***

In essence this theory is the study of media as environments. Within these environments, a number of constraints are placed upon the learner.

> "Environments structure what we can see, say, and do. They also assign roles and pressure us to play them. Media environments specify what we can do and what we cannot. In the case of media environments such as books, radio, film, and television, the technological specifications are more often implicit and informal, and therefore, the objective of media ecology. Media ecology tries to find out what roles media force us to play, how media structures what we are seeing or thinking, and why media make us feel and act as we do" (Scolari, 2012, p. 205).

Given that an on-line course can be considered its own environment, the design of the environment community requires developing a space where students and teacher can collaborate and share ideas. On-line courses using media and technology create a very different environment when compared with a traditional brick and mortar post secondary institution. The loss of face-to-face discussions is an obvious example that needs to be addressed. There are tools within learning management systems or chat rooms that can bring student and teacher together to continue the conversations on-line, such as Skype, Facetime and GoToMeeting.com. In on-line delivery, the virtual world community takes on a different importance than one in a classroom. According to Rimantas Plunge (2011) "environments are often construed structured in the social-cultural sense and these social relations are impossible without communication being

part of it" (p.85-86). Students learning from home may find these on-line discussions of more value, being their only connections to other students and the instructor. When designing these types of environments, understanding how the technology changes the environment is a key concept that must be considered when implementing effective on-line courses.

- ***Agenda Setting Theory***

This theory studies how mass media creates, frames and acts as a gatekeeper for ideas and events for individuals and social groups. Agenda theory "explores causes and consequences of gatekeeping trust, a new media trust construct defined as trust that the news media selects stories based on judgments of the relative importance of social problems" (Pingree, Quenette, Tchernev, Dickinson, 2013, p. 351). Messages that are selected and communicated to the masses by the news media are selected by an individual few who may give prominence to certain stories over others. Huck, Quiring and Brosius (2009) describe the basic idea of agenda setting as one where "the media [does] not directly effect people's opinions (what we think) but the agenda of issues we think about (public agenda) by highlighting some topics while neglecting or mentioning others in passing" (p. 141). Understanding this particular concept of communication theory can have a powerful effect on curriculum development. Framing the content for a learner in a particular way, perhaps using animations and other visuals in learning objects as apposed to text, may promote improved learning. This type of framing may help in connecting concepts to other ideas resulting in more meaningful learning for the student. Providing diverse ways in which curriculum is framed can appeal to different learning styles and thus create a more engaging

learning environment on-line. Researchers Lei Guo, Hong Tien Vu and Maxwell McCombs suggest that agenda setting contains three sub-processes: encoding, storage and retrieval. In the sub-process storage, "connections between new and old information [occur] in order to facilitate the storage of the new information in an individual's associative memory network" (Guo, Vu, McCombs, 2012, p. 55). Framing concepts and ideas to create new connections can facilitate meaningful learning for the student. Annie Lang (2000) argued, "the more a person links a new bit of information into this associative memory network, the better that information is stored. This process of linking newly encoded information to previously encoded information (or memories) is called storage. The more associations are formed between new and old information, the more completely the new information is stored" (p. 50). Using various mediums in the design of a learning object to frame a message or concept, keeping in mind that "storage is affected by both individual differences and by the resource limitations of the human information-processing system" (Lang, 2000, p. 53), can be an effective way to develop learning objects for on-line courses.

Today's youth use a variety of media in their everyday lives and incorporating it effectively can allow for more meaningful learning. As Chaebong Nam (2013) wrote, "tools are changing the nature of learning environments, not only broadening the scope of learning experiences but also encouraging youth to be creative and to take some initiative in their own education. Learning now takes place anywhere and at any time; the traditional divide between formal and informal contexts of learning is breaking down" (p. 24). Incorporating media effectively into curriculum design can

encourage a student to seek more information and connect new ideas to established ones. An on-line environment can be an environment of creativity and collaboration between peers or it can be a resource for materials. The design and development of curriculum, keeping in mind key communication concepts, can change the effectiveness of the course and the experience for students by developing strong messages and creating excellent communication within a course.

Technology in Education

With the advent of the Internet, the use of technology in education took on a different meaning than it did 30 years ago. Gone are the days of the film projector in the classroom. Today's technologies provide new options for curriculum delivery, stimulating engagement and meaningful learning for students. Simply creating PowerPoint presentations for on-line delivery is no longer adequate. Rather than simply offering passive PowerPoint presentations, a combination of both passive and interactive learning objects along with on-line discussions, would help in creating more engagement and interactivity for students. The question remains though, whether greater use of these technologies actually improves learning for the student. Many researchers in this field argue that technology does improve the cognitive memory of content while others argue that technology makes no significant difference. Whether curriculum is being designed for on-line or traditional face-to-face delivery, mindful thought into the design and development of learning objects to be used within the curriculum is imperative. "The focus of on-line learning should be on how to use the technology to enhance the learning outcome. It is about how the learners can learn more, learn more easily, learn faster and learn how-to-learn" (Neo, Eng, 2001, p. 65). Presenting information through the use of

technologies needs to be done so that learning objects aid in the development of critical thought and initiate conversation among students.

Learning Objects Benefits and/or Drawbacks

A learning object is something that can be used, reused or referenced and may be either digital or non-digital in its construction. Choosing the best way to deliver the learning object either through the use of technology or more traditional means is a choice that needs to be established at the design phase. One attribute to incorporate into a learning object is the ability to encourage collaboration or dialogue between students. Many researchers have found that collaboration is an "effective means of increasing student achievement and motivation to learn" (Jang, 2008, p. 855). Examples of technology that could be implemented to achieve collaboration and motivation would be the use of Wikis, discussion boards, live chat rooms and newsgroups (see Figure 1).

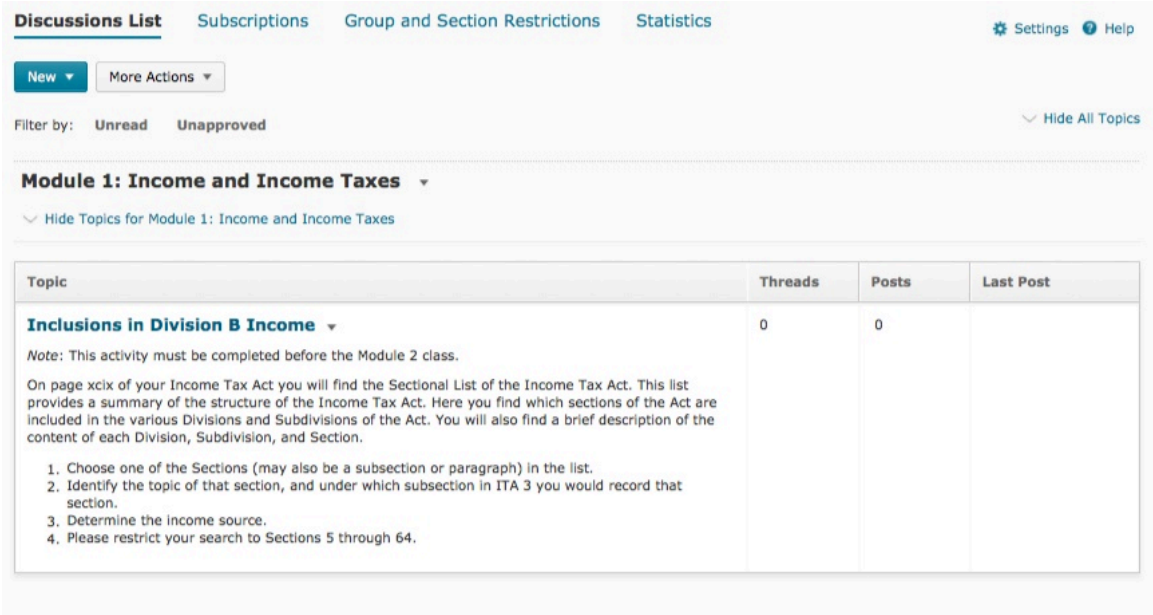

Figure 1: ***On-line Discussion Board*** *– an example of a discussion board in an on-line course. The goal is for the students to work on activities individually and then communicate their findings to the class creating dialogue. Courtesy of SAIT, © 2014*

With these tools, students are able to write about the information covered and make additional connections to other concepts. Researcher Syh-Jong Jang (2008) described writing as a tool to "remember information and master broad concepts through writing about them. Writing engages students in making connections between themselves and their subjects as well as in understanding the world in which they live" (p. 855). Some researchers maintain that computer mediated communication removes social anxiety and allows learners to feel more at ease in expressing their thoughts and ideas than they would in person. Theoretically, this would improve participation and as a result, provide more in depth dialogue.

Another technology that many find successful in on-line delivery are simulations or self-tests. This type of learning object allows a student to test themselves on their understanding of the information. Simulations (see Figure 2) have proven to be very effective when a process or piece of equipment has to be mastered. Often it is difficult for students to see all aspects of what an instructor is doing in the classroom.

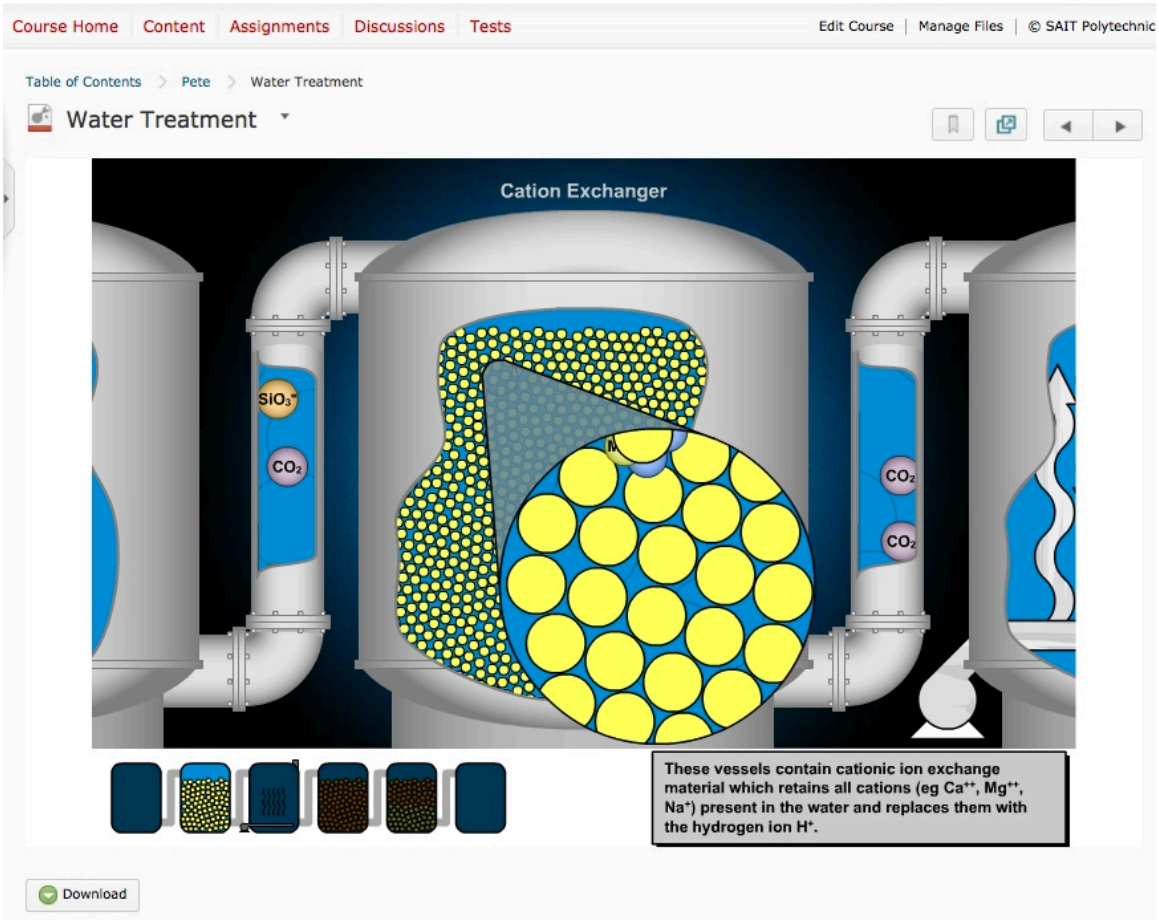

Figure 2: ***On-line Simulation/Animation*** *of water treatment with interactive components that illustrate each stage of water treatment as well as incorporating interactivity for the student that results in testing for themselves. - Courtesy of SAIT, © 2014*

The ability for a student to refer back to a simulation and practice the steps allows them to gain confidence in their abilities and as a result improves their success. “Simple self-tests and simulations are available for learners to assess themselves with prompt feedback on their performance to help them improve. This formative nature of assessment allows learners to build their competency over time” (Neo, Eng, 2001, p. 65). With a solid understanding of a particular part of a course, learners can engage in critical thinking and reasoning, resulting in meaningful learning.

On-line delivery should not be a mirror image of the classroom. On-line delivery design needs to be well thought out in order to create useful learning objects and develop

an engaging course (see Figure 3). "When technology is familiar to students, engagement increases; however, technology itself cannot produce dynamic student engagement without strategic use within the pedagogic process" (Bell, 2012, p. 14-15).

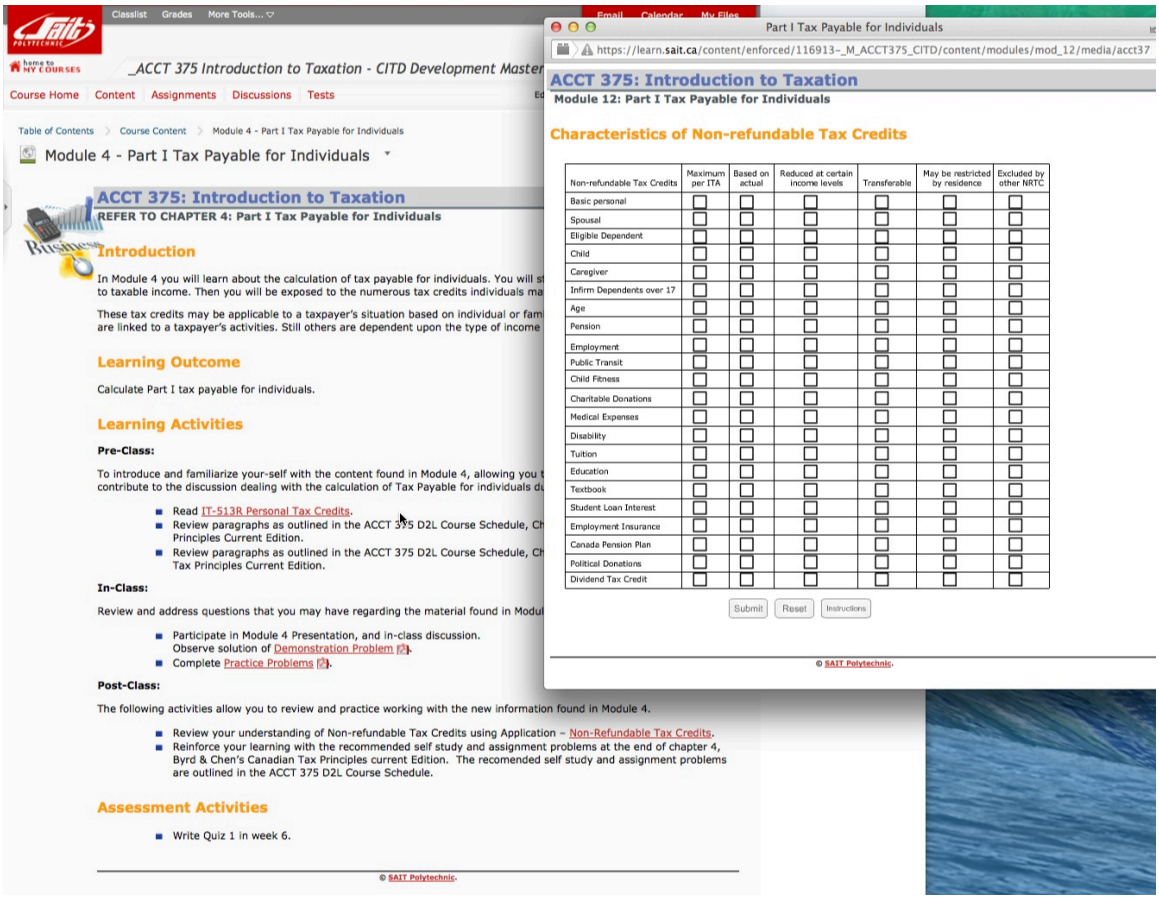

Figure 3: ***On-line Integration of Learning Object in Curriculum.*** *This example illustrates an interactive learning object that is linked off of the curriculum within the on-line course. The goal is for the student to read about the subject and then test themselves on the theories learned in the module/chapter. - Courtesy of SAIT, © 2014*

Well designed learning objects will encourage student use and promote questioning, which in turn will create critical thinking and result in meaningful learning for the student. When designing any on-line course the focus should be on the appropriate instructional strategy and integration of technology rather than on the technology itself.

Questions to Ask Yourself Before Developing Learning Objects

When designing learning objects for on-line courses, many questions should be asked prior to forging ahead with the actual design and development. Doing this will result in saved time, reduced costs and improve the effectiveness of the learning object. Once the content for a particular course has been identified, the focus can shift to finding areas that students find difficult to understand. These areas of difficulty may be ideal candidates for incorporating learning objects. Creating effective learning objects will improve understanding of the concepts and increase the meaningful learning for the student (see Figure 4A and 4B).

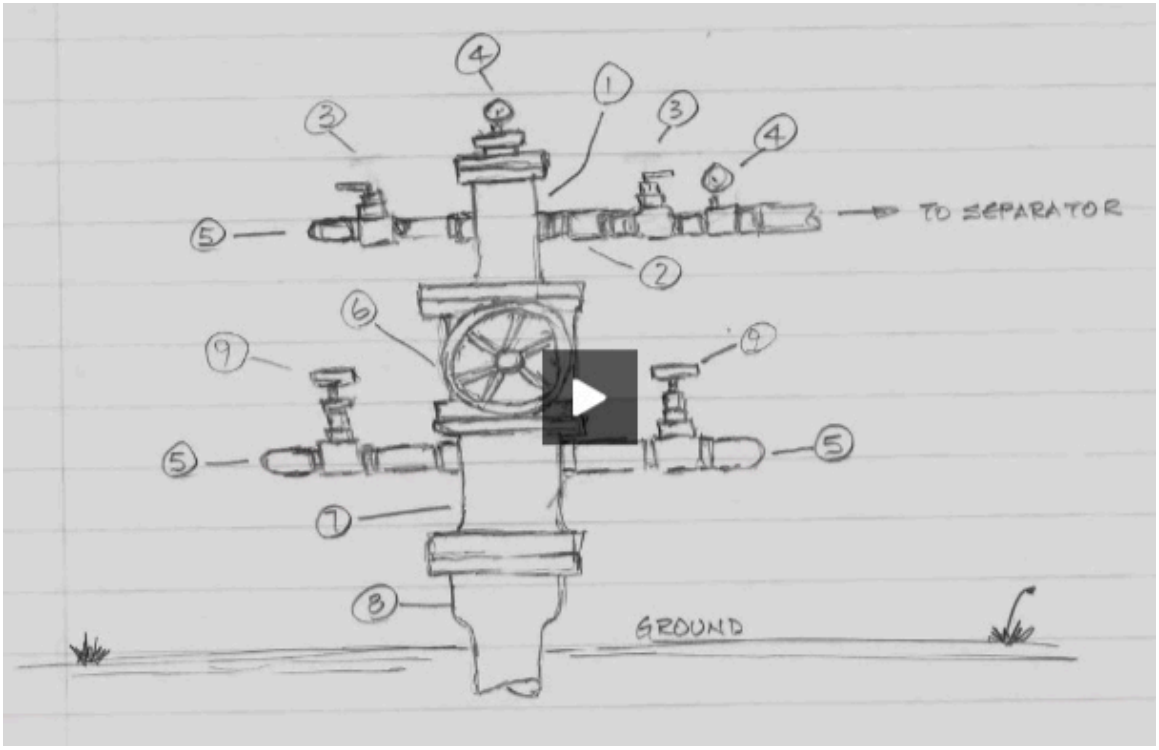

Figure 4A: ***On-line Graphic at Conception.*** *This example illustrates the sketch from a subject matter expert (SME) of a piece of equipment that will be created by a graphical artist. The goal of this drawing is for the students to identify the parts of the equipment illustrated. - Courtesy of SAIT, © 2014*

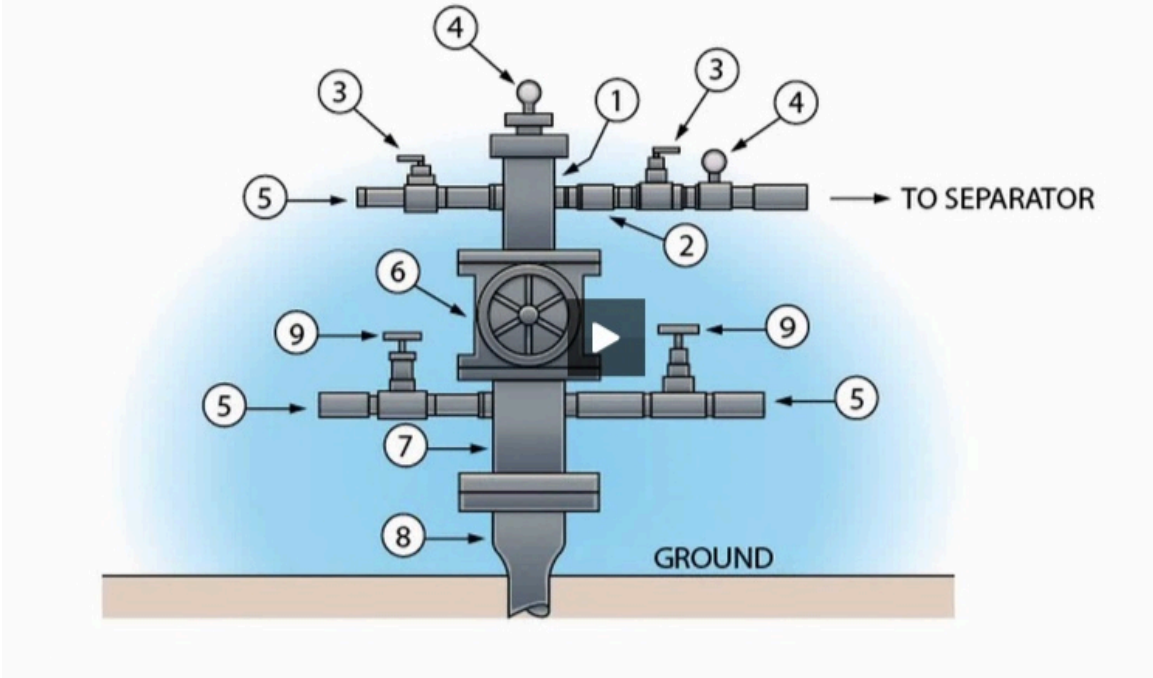

Figure 4B: ***On-line Graphic, completed artwork.*** *The same graphic shown above (Figure 4A) after development is complete. - Courtesy of SAIT, © 2014*

Abstract concepts and ideas in a course can often benefit from the use of learning objects to help the student more easily understand those ideas. Better understanding of core knowledge allows for the establishment of deeper connections to other concepts in the course and/or program. These connections can go a long way in creating meaningful and engaging learning for the student that may otherwise not occur. For example (see Figure 5), animations can create a visual representation of the functioning of a gas engine or create the steps that take place when microbes multiply.

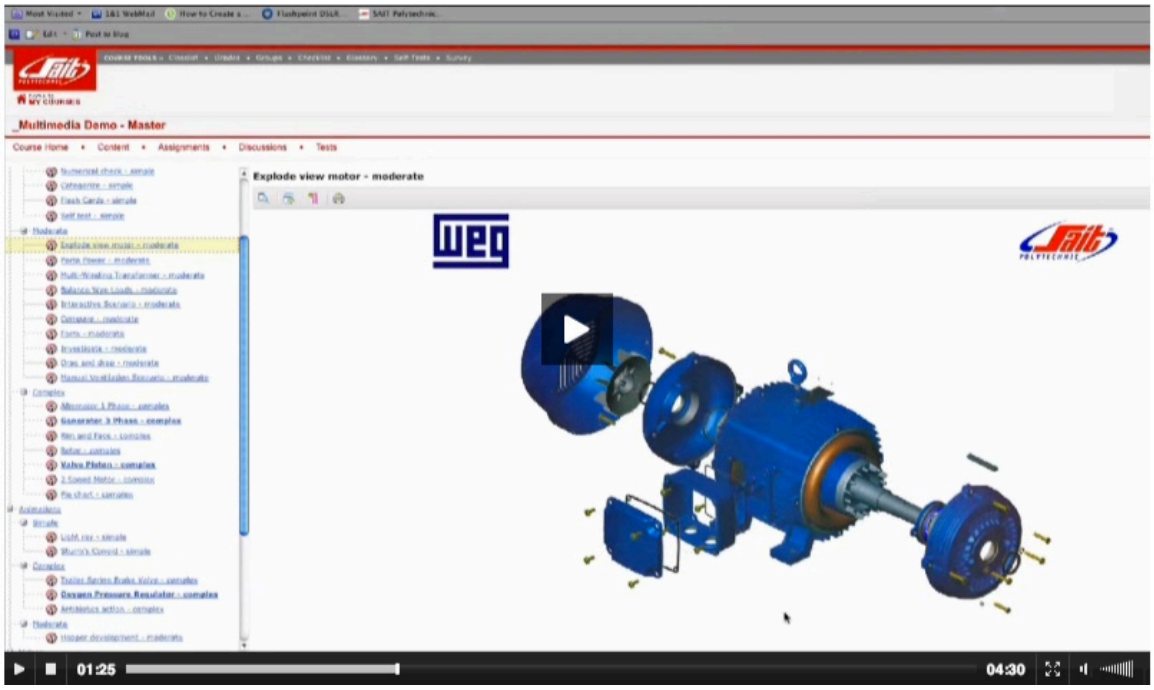

Figure 5: ***On-line Animation of Motor Parts****. This animation of a motor breaks apart to allow the student to see motor's components. In this case, the student can play and replay the animation repeatedly to get a full understanding of how the motor works, as well as identify its individual components. - Courtesy of SAIT, © 2014*

Another example would be to incorporate videos (see Figure 6) when students find it difficult to see a step-by-step process in the lab given by the instructor.

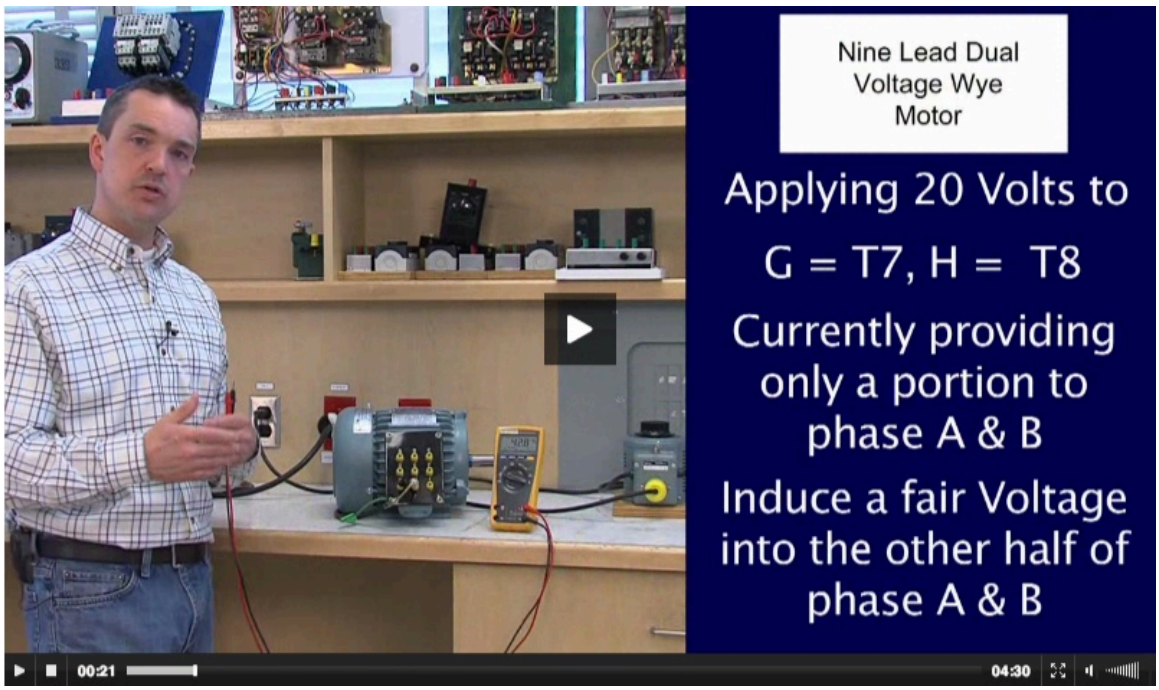

Figure 6: ***On-line Video Tutorial****, with live action and text elements- Courtesy of SAIT, © 2014*

These on-line videos can be an ideal resource for students as they give them the ability to refer back to and review the process before attempting to replicate it in the lab. Learning objects that include interactivity allow the student to test themselves on their understanding of a concept or to manipulate a piece of machinery in an environment safe from physical risks (see Figure 7).

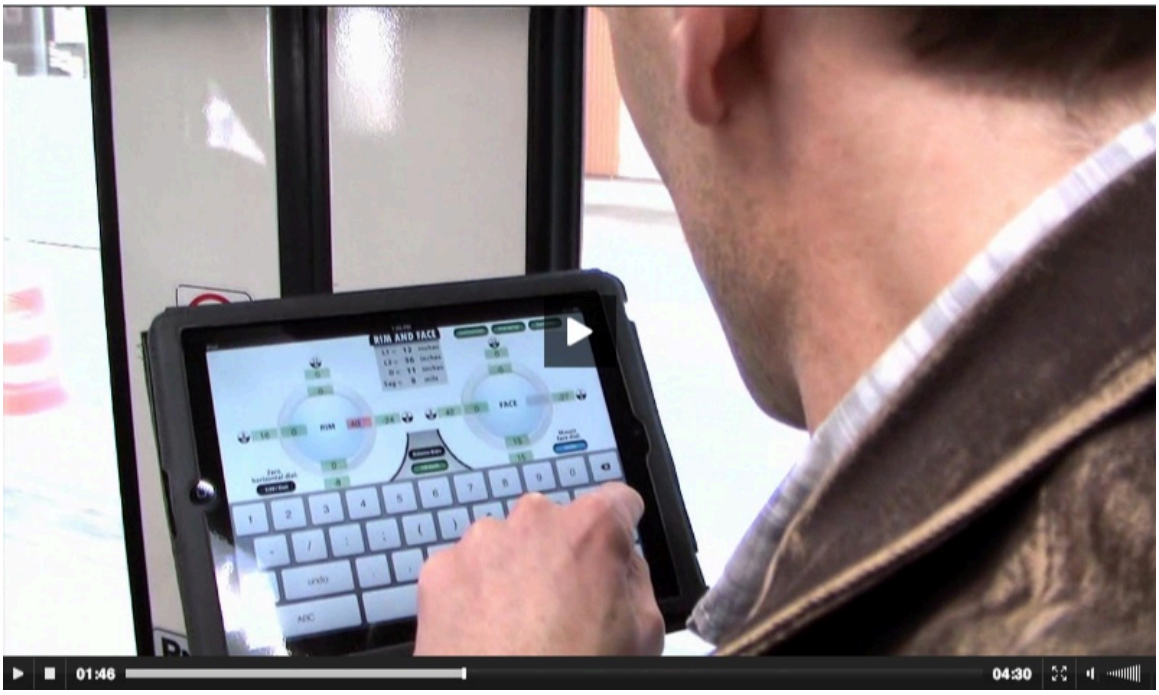

Figure 7: ***Portable Application for Use in the Field.*** *The development of Apps that can be used on portable devices allows students to use these as resources in the field. - Courtesy of SAIT, © 2014*

Various university and colleges have created standards for which their instructors are recommended to follow when designing and developing on-line curriculum and learning objects. Some highlights of these *best practices* from Alberta post-secondary institutions are as follows:

1. *eCampus Alberta:*

    - Activities should include higher order thinking skills.
    - A variety of instructional strategies are used to ensure compatibility with learners' different interests, abilities, and learning styles.
    - The material is organized in a way that allows learners to understand relationships between parts of the course.

2. *SAIT Polytechnic:*

    - The activity type is appropriate for the skill being demonstrated or practiced.
    - A variety of learning strategies are used for the activities.
    - The learning activities address pre-identified key learning challenges.

3. *NAIT*:

    - What concepts, skills, and/or issues must be integrated into the lessons to support achieving course outcomes?
    - Determine how the needs out there can be met through constructed learning experiences.
    - What formative assessment strategies best support assisting learning?
    - How do we ensure course resources appeal to a range of learning preferences and abilities?

4. *Other Points to Consider:*
    - What is the message you are attempting to communicate to the student?
    - Is there a procedure or process that students have difficulties with? What concept(s) do the students generally have the most trouble understanding?
    - Are there learning materials that can be packaged for easy retrieval at a later date?
    - How can an on-line community and an exchanging of ideas be simulated?
    - Can other tools, other than discussion boards, be used for on-line discussion that creates better connections between students?
    - Constant communication is created between students and facilitator. This creates connections and helps keep students engaged.
    - What tools best make connections between concepts and ideas?
    - Design for the on-line environment. Print material does not necessarily read the same on-line.
    - Does the use of a learning object enhance the learning by the student?

On-line learning began simply as a way to create an on-line resource that housed learning objects for the student. Today, post secondary institutions are attempting to design their on-line programs to facilitate more critical thinking and to create on-line communities for their students. Researcher Huy Phan (2011) defined critical thinking as "a process and not as an end in itself" (p. 202). Awareness has developed around the fact that "effective on-line learning is not just about putting information content on the Internet and facilitating access to it. It is about designing connectivity as a tool for the learner to use (see Figure 8 and Figure 9). The focus should therefore be on the learner and not the technology" (Neo, Eng, 2001, p. 62).

CEMENTING/ACIDIZING EQUIPMENT

The cement or acid mixing/pumping equipment consists of a pressure pumping truck, bulk cement hauler and water truck.

See Figures 2 and 3 for examples of cement or acid pumping units that mix and pump the cement or acid down the steel casing.

Courtesy of Trican Well Services
Figure 2: Cement Pumping Unit Body Job

Courtesy of Trican Well Services
Figure 3: Combination Cement / Acid Pumping Unit Trailer

Figure 8: ***Photos used in an On-line Course.*** *Using photos in an on-line course provides visuals that help the student understand the content. - Courtesy of SAIT, © 2014*

Figure 9: ***Table Use in an On-line Course.*** *In situations where there is a large amount of text, the use of tables helps break out the concepts and ideas into a more visual and organized layout. - Courtesy of SAIT, © 2014*

Creating learning objects for on-line development has to be more than utilizing available technologies. Simply using a variety of technologies does not directly translate into improved learning outcomes. Delia Baskerville points this out in the article, *Technology, Pedagogy and Education*. Baskerville (2012) writes, "Over the last two decades there has been a worldwide investment in educational technology based on the assertion that technology can help students learn more effectively, which would then lead to higher academic achievement, but little empirical evidence supports this claim" (p. 120).

Designing learning objects that facilitate critical thought and engaged learning is more than just the tool used to design or deliver it. "The focus should therefore be on the learner and not the technology" (Neo, Eng, 2001, p. 62). This user-centered focus comes out of constructionist theory, whereby knowledge is actively constructed and created (see Figure 10). In this type of theoretical model, "the role of the computer must be a tool that supports experimentation and active knowledge building through the creation, reflection on and sharing of artifacts" (Baskerville, 2012, p. 120).

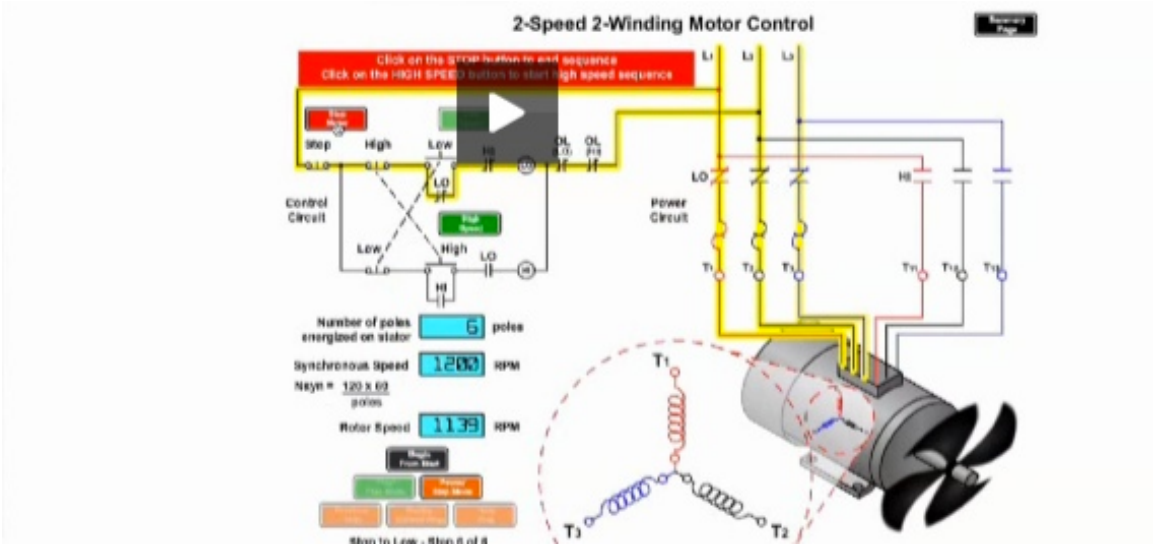

Figure 10: ***On-line Simulation of a Winding Motor Control*** *in an On-line Course. This simulation allows students to experiment with the piece of equipment and reflect on what they discover. - Courtesy of SAIT, © 2014*

Some researchers defend on-line learning for being an environment that is free of the fear of failure. Researchers Neo and Eng (2001) believe, "because the computer is an impersonal medium compared to classroom discussion, learners feel more at ease in expressing their thoughts on-line than in person" (p. 65). However, active student engagement is still key in the on-line world. Without it, an on-line discussion can result in feelings of disconnection and isolation for the student. To shape an environment free of the restrictions found in a traditional classroom, care must be taken to design

meaningful learning objects and on-line discussions. Only then will open dialogue and increased collaboration be achieved.

Evaluating Learning Objects and Goals

Designing and developing learning objects to incorporate for on-line delivery needs to be done with a mindful approach if the student experience is to be successful. Fortunately, today's various technologies provide many options for the development of learning objects for on-line delivery (see Figure 11).

A learning object's design should incorporate established instructional pedagogical principles. This will add to their value as a meaningful learner tool. The general design of the learning object should be well thought out and considered before any development takes place.

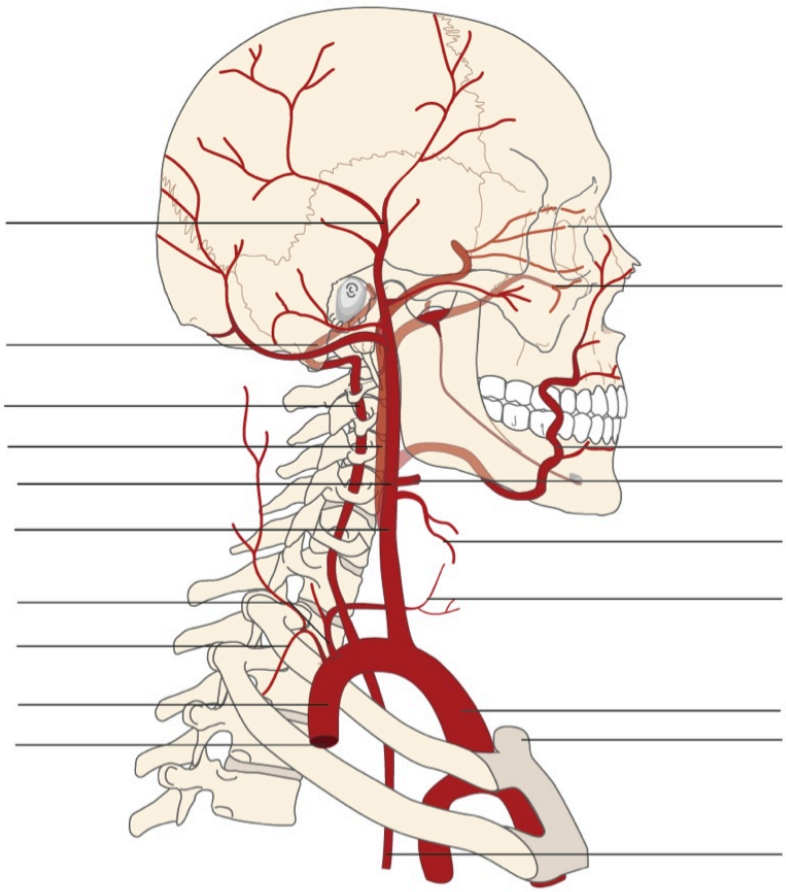

Figure 11: ***On-line Graphic*** *used to identify anatomical structure. The use of graphics is a simple way to create successful learning objects. Courtesy of SAIT, © 2014*

When designing for a learning object, many questions should be answered and the answers incorporated into the design. Some suggested guidelines for the creation and design of learning objects are as follows:

- The learning object has a clear objective and message.
- The learning object is specific and single in the content it presents.
- The learning object is easy to navigate and use for all students.
- The learning object creates discussion and connections to concepts - higher learning occurs.
- Each learning object should have a purpose for being in the course.

There are many forms of standards or best practices that various post-secondary institutes use. Many use similar questions to evaluate their own learning object's

effectiveness. A resource to evaluate learning objects in on-line delivery can be found in *Appendices 1*. Below are some highlights:

- Course is well organized and easy to navigate.
- A communication method is used and expectations are clearly laid out.
- Learning objects are easy to use.
- Learning objects provide useful and engaging information.
- Learning objects' message is clear.
- Facilitator promotes and is active in discussions.
- An on-line feeling of a community is created.
- Course materials are compatible with various computer platforms.
- Learning objects are used to convey information for meaningful learning.
- How are the students using learning objects?
- Do students find the learning objects an effective tool in their learning?
- Instructional materials are reviewed periodically to ensure standards are met and information is current and relative.
- Develop discussions that encourage critical thinking and sharing of experiences.
- Develop learning objects that present problem solving situations in a realistic context.
- Do pedagogical principles drive the use of a chosen technology when developing learning objects?
- Learning objects should be specific covering only one aspect of the course's content.
- Each learning object should be measurable.
- What is the student feedback on the learning object? Student feedback can be incorporated back into improving the learning objects and the course.

After an on-line course has been developed and used by students it is generally recommended that additional evaluations of that course and its learning objects take place. This will ensure that the course is achieving its objectives and desired outcomes. Many times a course will change and evolve as it is conducted and improvements can be incorporated into its design.

Goals to Achieve when Designing and Developing Learning Objects

When designing and developing learning objects for use in on-line delivery, a variety of objectives need to be considered. The ultimate goal is to encourage cognitive

learning that turns into critical thinking by the student, resulting in a more meaningful experience. Designing learning objects should attempt to find "ways to foster and assess meaningful learning, you need to emphasize those cognitive processes that go beyond remembering" (Mayer, 2002, p. 228). Designing learning objects that promote connections between known and new information allows students to make cognitive connections that result in understanding, interpreting, exemplifying, classifying, summarizing, inferring, comparing and explaining concepts and ideas.

When and How Best to Use Learning Objects

When developing learning objects that incorporate visuals and interactivity, these learning objects may help in creating better learner engagement. When designing such learning objects it is important to be mindful that it improves conceptualization of the concept presented in it and promotes meaningful learning for the student. Learning objects that are primarily passive create little meaningful thought and should be limited in use. The course design needs to also incorporate learning objects that appeal to a variety of learning styles. The ability for a student to work through activities with a variety of learning objects will foster critical thinking and help in creating greater connections. This type of learning has a greater appeal to various learner types such as the visual learner or the oral learner and improves learning for all students (see Figure 12).

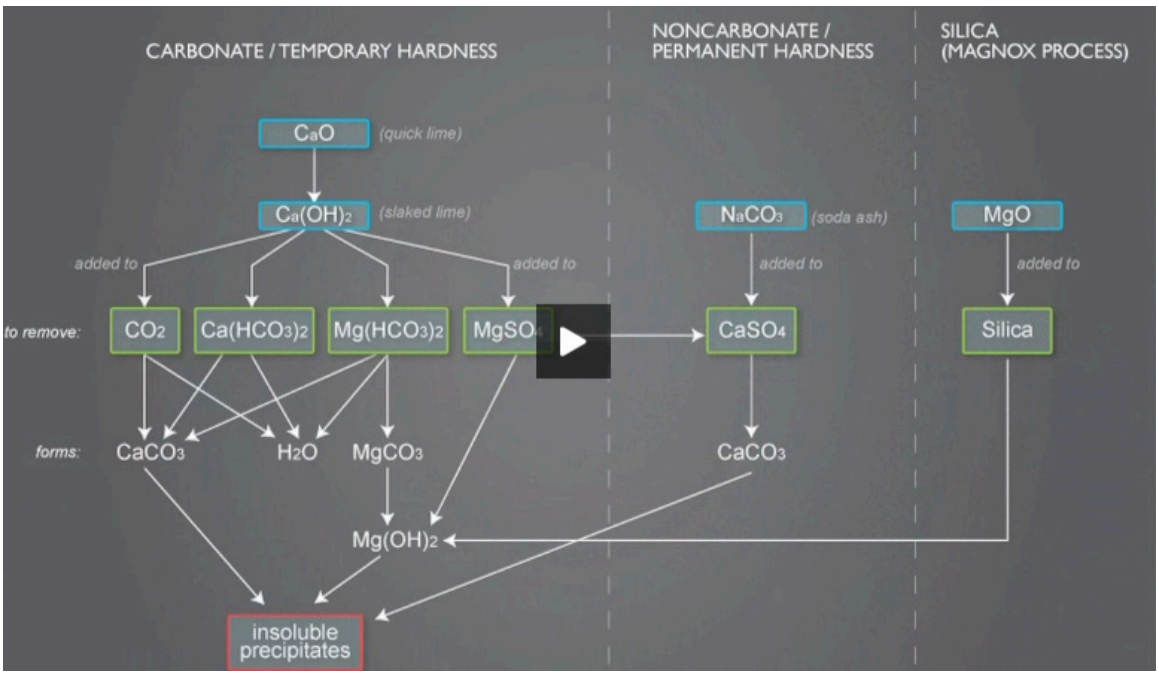

Figure 12: ***On-line Graphic*** *illustrating insoluble precipitates. This illustration demonstrates how a graphic can show various chemical compounds working together to form insoluble precipitates. - Courtesy of SAIT, © 2014*

In situations where demonstrations are difficult to do, such as a large classroom, video and/or simulations can be of a great benefit to the student. The ability for a student to refer back to a video or to practice on a piece of equipment virtually is a powerful resource for the student. Learning objects such as these create an engaging environment that allows for play and experimentation by the student and translates into cognitive connections. The idea behind learning objects here is the promotion of self-study and self-exploration. "The ideal learning environment is built for students to self-study with media technology. Constructivist theory suggests human learning is neither a simple rendering of external things, nor a human cognitive structure of the original commencement, but construction of meanings established step by step for external things in the process of the human interaction with the external things" (Qingsong, 2012, p. 1555).

Choosing the Right Tool for the Job

Choosing the right tool for the development of any learning object can be a difficult task. With so many technologies available to instructors, it may be difficult to pick the best delivery method. There are typically multiple ways of developing a learning object and presenting the material. The question to ask is; what is the ultimate objective of this piece and what way is best to deliver that message? (see Figure 13)

Description of Meridians

A meridian is a north-south line on the earth's surface. The Principal Meridian is followed by successive meridians (Second, Third, Fourth, Fifth and Sixth), each about four degrees of longitude apart. The Fourth Meridian is the Alberta-Saskatchewan boundary. The western provinces extend northward from the 49th parallel (Canada-United States boundary) to the 60th parallel, a distance of about 760 miles (1,224 kilometers).

Meridians follow the curve of the Earth and they converge as they run northward. The distance between the Fourth and Fifth Meridians along the 49th parallel is about 182 miles (293 kilometers). At the 60th parallel the distance between the same two meridians is reduced to about 139 miles (224 kilometers) due to the convergence of the meridians.

The Table below describes each of the meridians and their locations.

Table 2.1 – Meridians and Locations

Meridian	Abbreviation	Approximate Map Location
First, or Principle Meridian	W1M, WPM	Winnipeg, Man.
Second Meridian	W2M	Along part of the Sask.- Man. border
Third Meridian	W2M	West of Prince Albert, Sask.
Fourth Meridian	W4M	Along Alta.- Sask. Border
Fifth Meridian	W5M	Through Calgary, Alta.
Sixth Meridian	W6M	Through Peace River Country, Alta.
Seventh Meridian	W7M	West of Peace River Block, B.C.
Eighth or Coast Meridian	W8M	Located slightly east of the confluence of Pitt River and Fraser River, B.C.

Figure 13: ***On-line Use of Table in Curriculum Content.*** *The use of tables within written content helps in organizing and categorizing ideas to form connections. - Courtesy of SAIT, © 2014*

Designing and developing learning objects with the primary objective to develop connections between concepts and ideas can be accomplished in many ways. When developing learning objects for on-line delivery, the designer should attempt to vary the ways of presenting the material. This will not only create engagement but accommodates

the various learning styles and needs of the students. "When one kind of media delivery does not meet the requirements, other media can be supplemented. Therefore, it is necessary to optimize teaching and learning media with different performance to avoid weaknesses in the teaching process, and apply interactively, and harmonize the teaching effectiveness" (Qingsong, 2012, p. 1556). When designing and developing a learning object the *what, where, why, who and how* of the situation needs to be addressed. The learning object should present the content in the most effective manner that communicates its purpose and breaks up the information in a way that does not overload the student's cognitive learning process (see Figure 14).

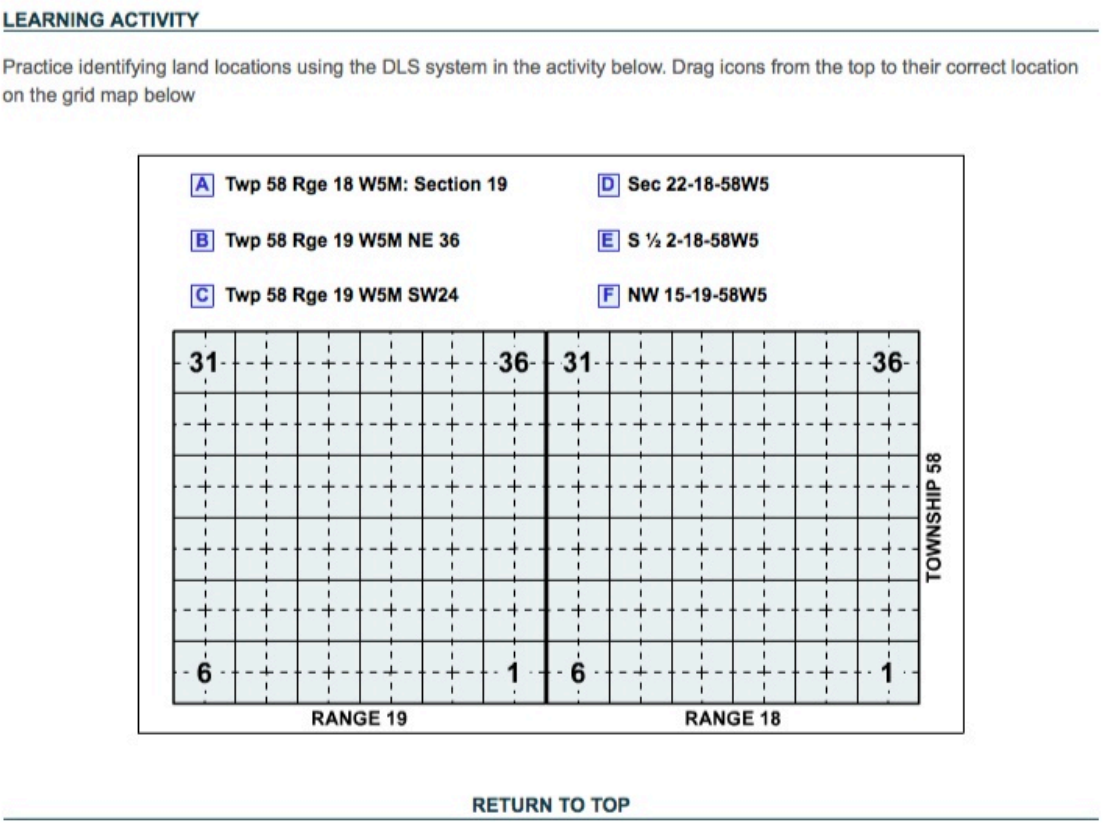

Figure 14: ***On-line Use of Table in a Learning Object.*** *Tables can also be developed into interactive tables that can then be incorporated into the content. - Courtesy of SAIT, © 2014*

Doing so will promote engagement and encourage a dialogue between classmates within their on-line community. Strong pedagogical design should be the underlying primary objective when developing any learning object. Sound design increases the transfer of knowledge and meaningful learning by the student and promotes knowledge to be applied in real life situations or to other concepts and ideas. "It is about designing connectivity as a tool for the learner to use. The focus should therefore be on the learner and not the technology" (Neo, Eng, 2001, p. 62). The choice of the technological tool should almost become secondary when developing learning objects. Because of the self-study aspect of on-line delivery, feedback, interactivity and involvement within the course will help improve the student's competency as well as the transfer of knowledge from student to student or instructor to student.

Media and Technical Support for Faculty

Today's technology changes very quickly and many teachers labour to keep up with the trends or fully integrate them into their curriculum due to their lack of awareness of these technologies. "Many teachers struggle to utilize digital media in a way that develops pupil engagement, and that learning is viewed as a process where knowledge is primarily transferred not constructed" (Baskerville, 2012, p. 130). Working closely with someone for technical support as well as those with an instructional developer background may help improve learning objects as both individuals can bring their respective expertise and viewpoints to the design and development.

Integration of media and multimedia can foster engagement for the student and provide a major contribution to curriculum. Deborah Cohen (2010) wrote, "The ability of media to represent real objects can be of great educational value. Media allows

designers to communicate about objects, representations, and ideas about reality that would not otherwise be possible" (p. 74). A developer of multimedia can work closely with faculty and an instructional designer to design learning objects that represent items that would be more difficult to develop by an instructor acting alone. Team support for faculty will help ensure improved learning objects and on-line courses, which will result in improved student success. However, just as well designed learning objects can improve student learning, poorly designed ones can place too much emphasis on the graphical design and not enough on solid learning methodologies. The result can be a burden on the learner, as they have to filter the content to pull out concepts that are important to the actual learning. Well thought out curriculum design will lead to improved learner satisfaction. For those instructors working independently on the development of learning objects for curriculum design, *Appendices 2* provides examples and links to on-line tools. The variety of tools available will assist an instructor in developing their own learning objects for incorporation into the classroom or on-line environments.

Today's rapidly changing technologies increases the pressure on the instructor to keep up with trends and use the latest technology in their instructional material. Even with the help of a dedicated team of Instructional Designers and Multimedia Developers, an instructor has a difficult task in incorporating technology and learning best practices when facilitating an on-line course. Professional development (PD) is an area that educators and management are realizing is becoming more important. Assistant professor Donna Bell describes PD as more necessary today than in years past. Bell writes, "A shift in the thought process of professional development is in order.

Professional development opportunities should not be viewed as a one time opportunity to demonstrate a new skill or deliver educational procedures" (p. 21). Like today's student, life long learning is a concept that also impacts today's instructors.

Conclusion

On-line delivery is becoming more and more commonplace and along with this type of delivery is the increasing use of learning objects. Designing learning objects needs to be well planned and developed in order for them to be beneficial for the student. Simply loading print material into an on-line course does not suffice. When developing any on-line course, working closely with an instructional designer and a multimedia developer will help in creating engaging, pedagogically sound learning objects. Discerning what concepts students have difficulty with and developing those into learning objects may go a long way in fostering engagement and connecting ideas. Doing this increases the possibility of developing critical thought processes and meaningful learning for the student. Learning objects need to have purpose and encourage engaged dialogue. These constructs can be then applied to others knowledge or real life situations resulting in a more successful student experience. The art is in the designing and developing of those learning objects. The skill is in knowing how and when to incorporate them into the curriculum – just because you can do something, does not mean you should.

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Appendices 1A – Evaluating Learning Objects

Learning Object - Effectiveness	Yes	No	N/A	Comments
Learning object easy to navigate and use.				
Learning objects provide useful and engaging information.				
Learning objects' message is clear.				
Is the objective of the learning object clear to the student?				
The learning object is technology simple enough for all student use.				
Does the learning object create a conversation?				
Does the learning objects utilize the latest technologies available?				
Is the learning object using the most appropriate technology for the message or information it is delivering?				
Does the learning object create a conversation?				
Does the learning objects utilize the latest technologies available?				
Is the learning object using the most appropriate technology for the message or information it is delivering?				
Does pedagogical principles drive the use of a chosen technology when developing learning objects?				

Learning Object - Effectiveness	**Yes**	**No**	**N/A**	**Comments**
Is student feedback incorporated back into learning object for continued improvement?				
Learning objects are problem-based, simulations, role-playing or case based, guided learning and exploratory or discovery based.				
Learning objects are designed to require students to engage, analysis, synthesis and evaluate the content that is being presented.				
On-line Community	**Yes**	**No**	**N/A**	**Comments**
A communication method is used and expectations are clearly laid out.				
An on-line feeling of a community is created.				
Develop discussions that encourage critical thinking and sharing of experiences.				
Overall Course Material	**Yes**	**No**	**N/A**	**Comments**
Instructional materials are reviewed periodically to ensure standards are meet and information is current and relative.				
Course materials are compatible with various computer platforms.				

Appendices 1B - Examples of a Good Vs. Bad Learning Object Designs

DISCIPLINES INVOLVED IN PRE-ACQUISITION OF DEVELOPED ASSETS

As with the pre-acquisition of undeveloped assets, various disciplines are involved in the pre-acquisition of developed assets.

Mineral Land

Mineral Land is involved in pre-acquisition of a developed asset if the mineral land and rights need to be acquired. Similar to the undeveloped asset pre-acquisition phase, in developed asset pre-acquisition, Mineral Land will explore acquisition options and determine how the land and rights can be obtained.

Often, developed land assets will be obtained through a contract or a Purchase and Sale (P&S) agreement. Due diligence will be performed on any mineral lease and contracts to ensure they have been maintained, and that all terms have been met to keep the agreement in effect.

If a company is developing an area, it may be able to pick up parcels at Public Land sales or through freehold owners in the vicinity of the area they have already developed. This can greatly increase the size of a company's total area asset. Bid amounts or bonus consideration are determined and an offer is submitted. The submission of an offer of land signifies the transition into the Acquisition phase.

Surface Land

When acquiring developed assets, Surface Land will ensure all provincial directives have been followed and that the asset is in good standing with governing agencies such as the Alberta Energy Regulator (AER).

Joint Venture

Joint Venture will review existing Unit, Construction, Ownership and Operating (CO&O) and Service agreements and infrastructure to identify Joint Venture opportunities when a company is looking at the pre-acquisition of a physical asset.

Well Asset Management (WAM)

If a well is to be acquired, the well asset management team will review regulations to ensure that the current owner has met all reporting requirements. Before the wellbore is purchased, the team will ensure all reporting and requirements on the wellbore have been met and determine what information should be received. Once the asset is purchased, the purchasing company is liable for issues that may arise.

Operation Accounting

Operations Accounting will handle the interim and final statements of adjustment during the pre-acquisition phase.

DISCIPLINES INVOLVED IN ACQUISITION OF UNDEVELOPED ASSETS

Return to Top

Mineral Land

The Mineral Land team is responsible for acquiring the mineral rights. If the land is freehold, the mineral land negotiator will finalize an agreement with the landowners. If the land is held by the Crown, it will undergo a process set out by the government.

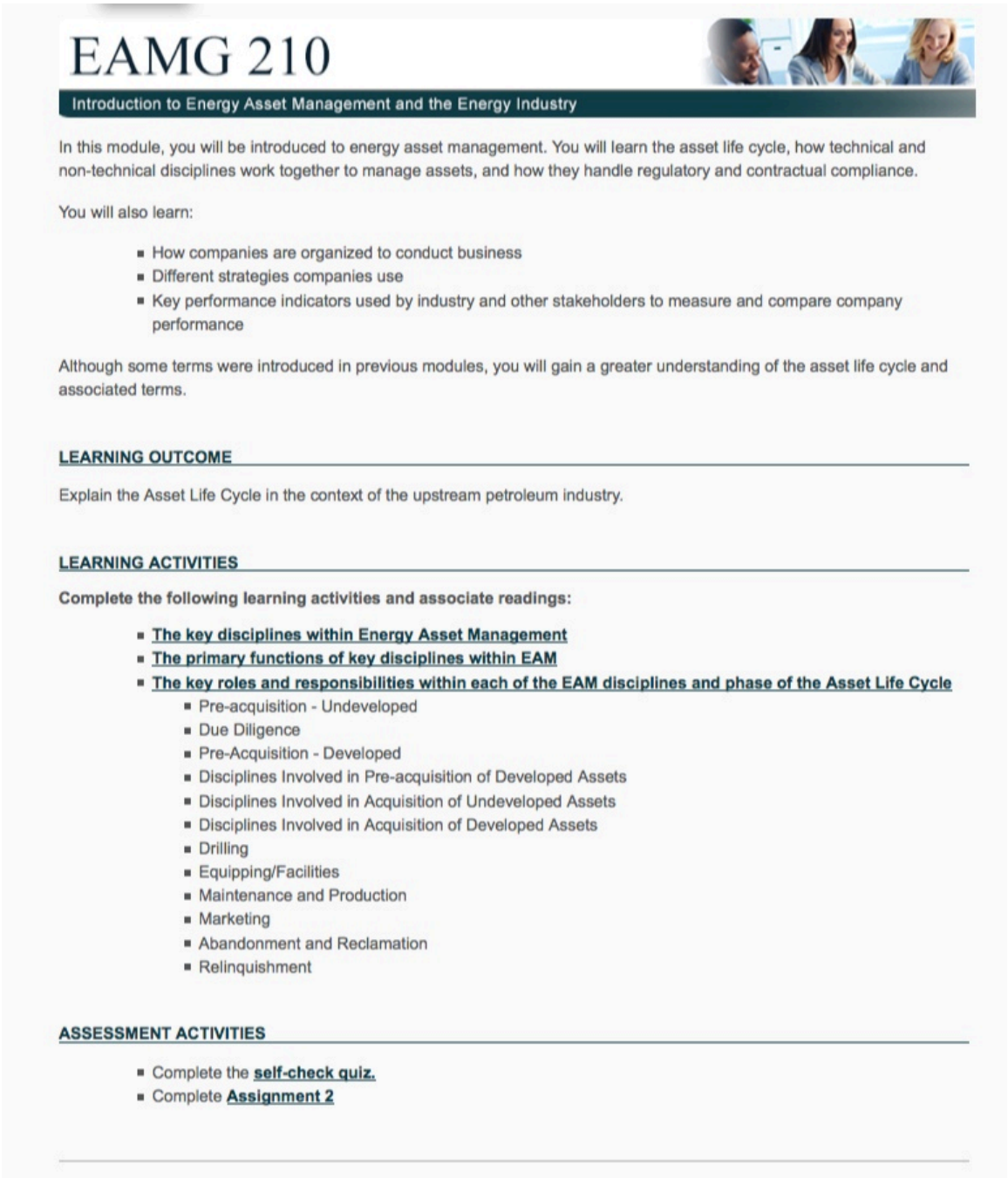
In Alberta, after posting land in a land sale, a company will make a bid on the lands in the sale. The bidding is done online through the ETS system. If the company is successful in its bid, the Crown will issue a document that outlines the terms of the agreement.

If partners are involved in the acquisition, a negotiator will negotiate the terms of a Joint Operating Agreement between the companies, and a contract will be drafted and executed by both or all parties.

All agreements, regardless of ownership, both lease related and contract related, must be set up as a physical file and in the Land system of the company.

Surface Land

The Surface Land team acquires all the necessary documents needed to acquire access to the surface land location. A Land Agent will negotiate a Surface Lease if the lands are owned by a freehold owner.



EAMG 210

Introduction to Energy Asset Management and the Energy Industry

In this module, you will be introduced to energy asset management. You will learn the asset life cycle, how technical and non-technical disciplines work together to manage assets, and how they handle regulatory and contractual compliance.

You will also learn:

- How companies are organized to conduct business
- Different strategies companies use
- Key performance indicators used by industry and other stakeholders to measure and compare company performance

Although some terms were introduced in previous modules, you will gain a greater understanding of the asset life cycle and associated terms.

LEARNING OUTCOME

Explain the Asset Life Cycle in the context of the upstream petroleum industry.

LEARNING ACTIVITIES

Complete the following learning activities and associate readings:

- **The key disciplines within Energy Asset Management**
- **The primary functions of key disciplines within EAM**
- **The key roles and responsibilities within each of the EAM disciplines and phase of the Asset Life Cycle**
  - Pre-acquisition - Undeveloped
  - Due Diligence
  - Pre-Acquisition - Developed
  - Disciplines Involved in Pre-acquisition of Developed Assets
  - Disciplines Involved in Acquisition of Undeveloped Assets
  - Disciplines Involved in Acquisition of Developed Assets
  - Drilling
  - Equipping/Facilities
  - Maintenance and Production
  - Marketing
  - Abandonment and Reclamation
  - Relinquishment

ASSESSMENT ACTIVITIES

- Complete the **self-check quiz.**
- Complete **Assignment 2**

***Example B** of a On-line Course - Courtesy of SAIT, © 2014*

The examples above illustrate how content and learning objects could be incorporated into an on-line course. Example B is a good example of how content can be broken up and organized within an on-line environment. The learning objects designed for this course link from this page, allowing for interactivity. The student can test

themselves on their knowledge of the content being presented. The result is greater connections between ideas and concepts throughout the course. Example A illustrates a course design utilizing a text only layout. The student is required to read a large amount of on screen material, which can be ineffective. With little interactivity between the course material and the learner, critical thinking skills are diminished for the student. When faced with this type of course design, there is the risk of the student becoming disengaged and/or unmotivated.

Appendices 2 – Tools to Develop Learning Objects

Development Tools:

- Microsoft PowerPoint
- Articulate (www.articulate.com)
- Adobe Cloud Suite
- Captivate
- White Boards
- Social Media tools:
    - Blogs (e.g. Wordpress (http://www.wordpress.com))
    - YouTube (http://www.youtube.com)
    - Flickr (https://www.flickr.com)
- Google Docs (https://docs.google.com/)
- Microsoft OnDrive (https://onedrive.live.com/about/en-us/)
- wolframalpha.com (http://www.wolframalpha.com/)

Images:

- iStock (http://www.istockphoto.com/)
- thinkstock (http://www.thinkstockphotos.ca/)
- Creative Commons (http://creativecommons.org/)
- Getty Images (http://www.gettyimages.ca/)

Videos/Animations/Interactive Pieces:

- YouTube (http://www.youtube.com)
- iTunes (http://www.apple.com/ca)
- Public Libraries on-line video collection
- College/University Libraries on-line video collection
- A on-line search for copyright free learning objects in your field