Steps & Lessons on Converting to a Competency-Based Hybrid Model Part 2

Presented by:

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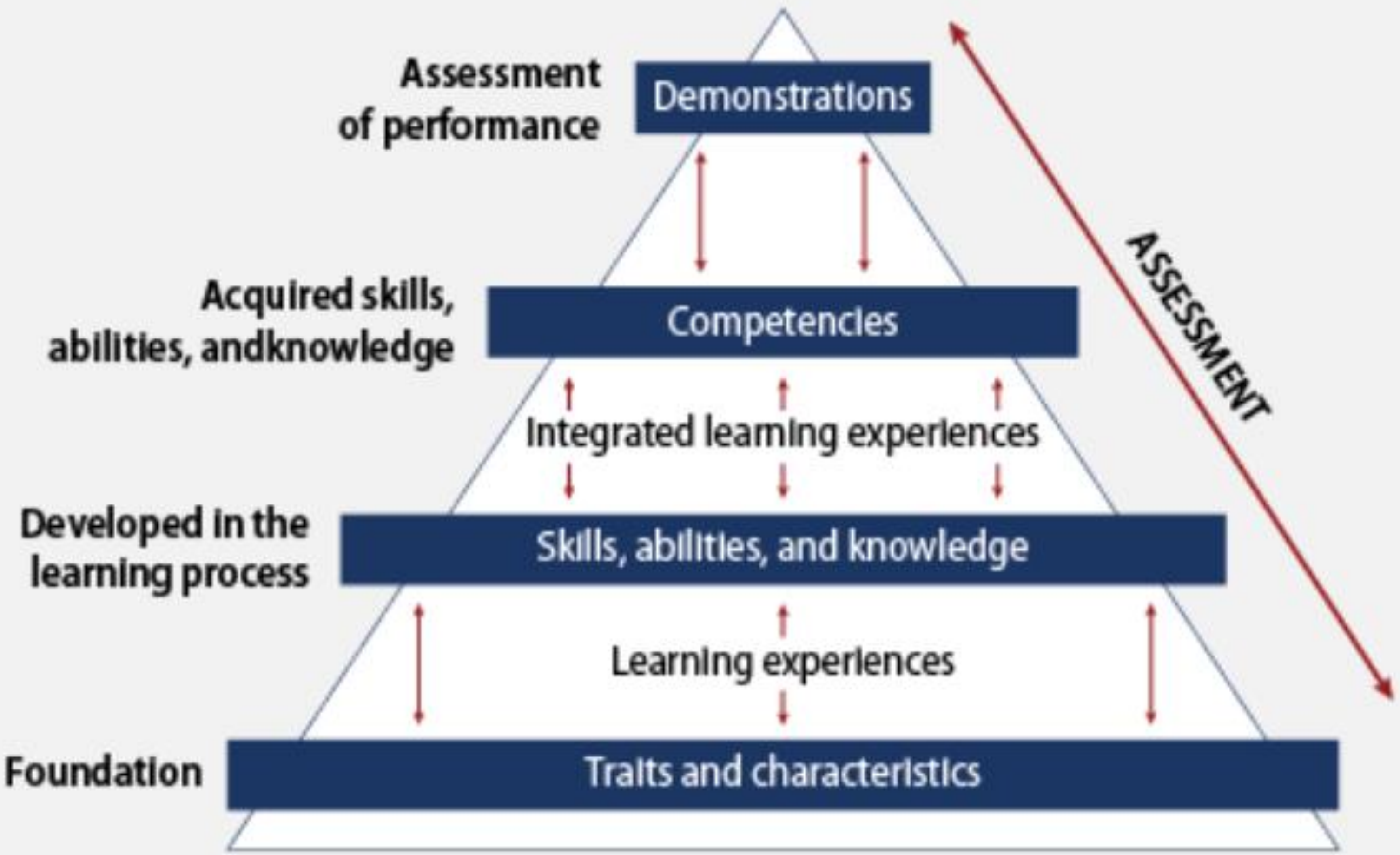
Workshop Materials Available for Download:

https://ate.is/Scaling_CBE

FIGURE 1

A conceptual learning model



Source: U.S. Department of Education, 2001.

A traditional model has typically 2-3 written or online assessments.

A CBE model has many more assessments so the faculty can determine mastery of the knowledge/skill of each student in each module.

Northwest State Community College

DACUM Competencies

- **D**evelop **A CU**rricul**uM**
- 5-7 Industry SMEs meet for 2-3 days to identify all the duties and tasks required for a technology or a job
- At least part of your competencies should be obtained from a DACUM, which you can then say are validated.
- VET all competencies through the Industry SME group
- Do not start from scratch. Start with Competencies and Outcomes from other ATE projects. Show the AMTEC competencies.

DACUM results for a Class 2 Water Operator in Ohio.

DACUM is an Ohio State format

DACUM Research Chart for Class 2 Water Operator

Duties	Tasks				
A Manage Source Water	A-1 Identify source water area	A-2 Collect raw water samples	A-3 Review raw water lab results	A-4 Develop source water protection program	A-5 Implement source water protection program
B Manage Treatment Processes	B-1 Complete facility inspection	B-2 Monitor SCADA system	B-3 Obtain chlorine sample results	B-4 Obtain fluoride sample results	B-5 Obtain turbidity sample results
	B-13 Adjust water treatment rate	B-14 Adjust chemical feed rates	B-15 Fill chemical day tanks	B-16 Backwash filters	B-17 Regenerate water softeners
	B-24 Calibrate bench top meters	B-25 Change flow charts	B-26 Refill bulk chemical storage	B-27 Unload chemical deliveries	B-28 Complete daily worksheet
C Comply with EPA Sample Requirements	C-1 Collect SOC samples	C-2 Collect VOC samples	C-3 Collect TTHM/HAA5 samples	C-4 Collect radiological samples	C-5 Collect lead & copper samples
	C-13 Collect organics samples (e.g., benzene, carbon tetrochloride, toluene)	C-14 Collect cryotosporidium/ giardia samples		C-15 Collect special bacteria samples	C-16 Collect dissolved oxygen samples
D Manage Distribution Processes	D-1 Monitor chlorine/ chloride residual levels	D-2 Develop backflow prevention program	D-3 Implement backflow prevention program	D-4 Inspect booster stations	D-5 Inspect water towers
	D-13 Maintain hydrants	D-14 Exercise valves	D-15 Read meters	D-16 Maintain meter pit integrity	D-17 Rotate booster/lift station pumps
E Perform Preventive Maintenance	E-1 Develop preventive maintenance program	E-2 Change oil/fluids in equipment (e.g., motors, compressors)	E-3 Grease equipment (e.g., pumps, valves)	E-4 Test-run equipment (e.g., pumps, valves, generators)	
	E-12 Calibrate	E-13 Calibrate	E-14 Calibrate	E-15 Oversee	E-16 Rebuild

DACUM format for Control Technicians DACUM format by AMTEC in KY

AMTEC Duties and Tasks from Original Turbo-DACUM Session

A		MECHANICAL EQUIPMENT
	1	Troubleshoot/repair/replace brakes & clutches (electromechanical and mechanical)
	2	Troubleshoot/repair/replace gears
	3	Troubleshoot/replace belts, sheaves/pulley
	4	Troubleshoot/maintain chains and sprockets
	5	Troubleshoot/repair/replace cams
	6	Troubleshoot/repair/replace seals and o-rings
	7	Troubleshoot/repair/replace bearings and bushings
	8	Troubleshoot/repair/replace shafts
	9	Perform alignment and balancing
	10	Troubleshoot/repair/replace motors (AC and DC)
	11	Maintain couplings
	12	Maintain fans
	13	Install/maintain valves (cut-off, pressure relief...)
B		PNEUMATIC/HYDRAULIC EQUIPMENT
	14	Troubleshoot/repair/replace pneumatic/hydraulic valves
	15	Troubleshoot/repair/replace cylinders and intensifiers
	16	Troubleshoot/repair/replace hoses and tubing
	17	Adjust pressures and flows mechanically and electronically
	18	Maintain fluid levels for hydraulic systems
	19	Replace filters on hydraulic/pneumatic systems
	20	Troubleshoot/repair/replace gauges
	21	Troubleshoot/repair/replace pneumatic/hydraulic pumps
	22	Troubleshoot/replace accumulators
	23	Troubleshoot/repair/replace air motors
	24	Maintain vacuum system on pneumatic equipment
	25	Maintain filtration systems
	26	Adjust switches and controls on hydraulic/pneumatic system
	27	Install/design hydraulic/pneumatic components to upgrade/enhance systems

AMTEC was an NSF Center and facilitated numerous DACUMs

AMTEC is no longer funded by the NSF, and was absorbed into the Kentucky Technical and Community College system.

1032ab: PLC – Allen-Bradley Hardware and Software (I/O) (Module 15)

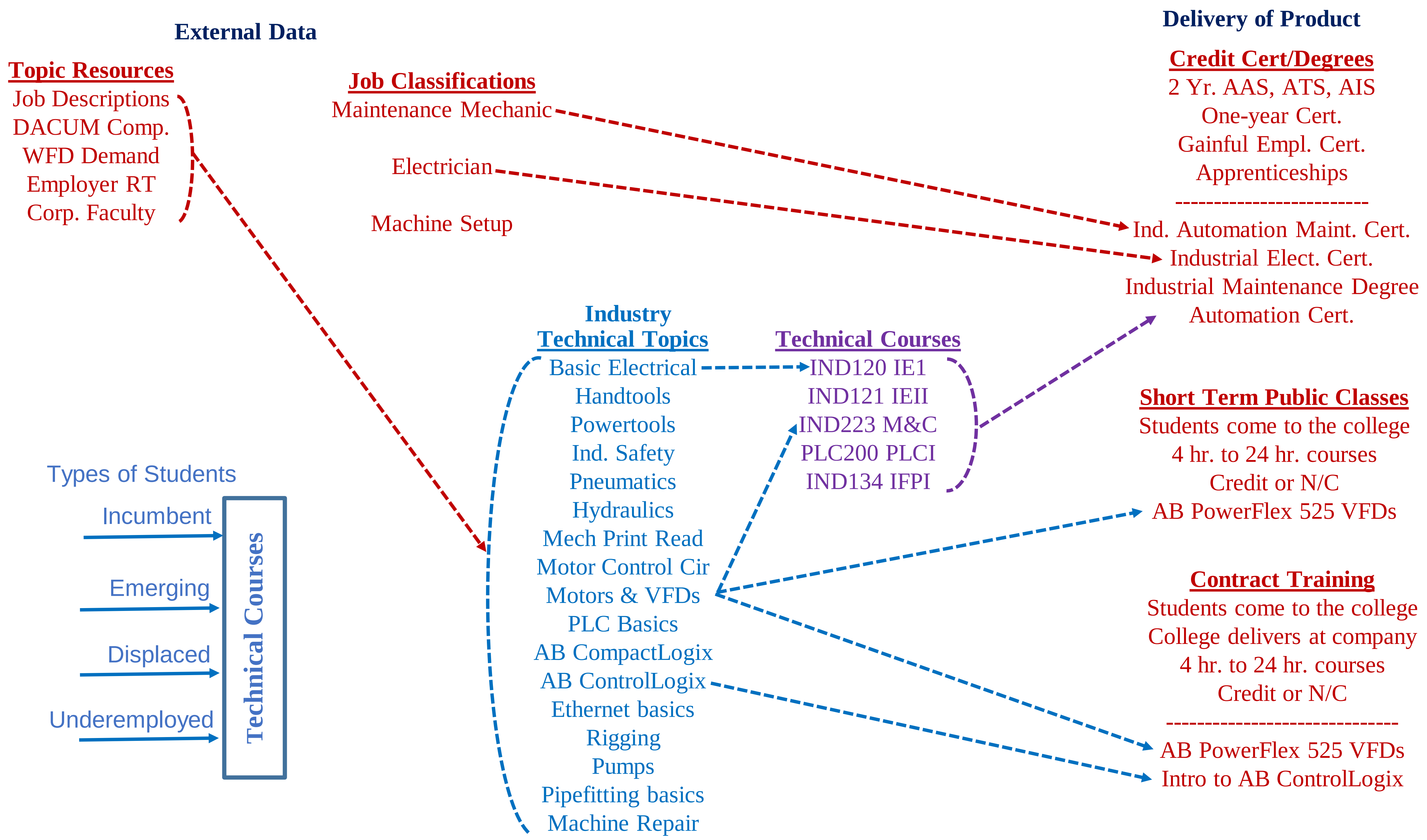
Lecture Contact Hours: 10
Lab Contact Hours: 20

Description:
This module introduces the student to the memory and project organization within a ControlLogix processor, the installation, wiring and configuration of I/O modules, as well as how to start a new project using RSLogix 5000 software.

Competencies:

1. Provide a brief overview of Rockwell's integrated architecture (hardware & software).
   - 1.1. Describe where different Rockwell software applications are used.
   - 1.2. Describe the different types of networked communications and I/O configurations that are supported within Rockwell's Integrated Architecture.
2. Describe the ControlLogix memory & project organization.
   - 2.1. Describe the ControlLogix project organization model.
   - 2.2. Explain the relationship between tasks, programs and routines.
   - 2.3. Identify RSLogix 5000 project files based upon their file extension.
   - 2.4. Describe the different types of task execution.
   - 2.5. Describe the order of execution for programs within a task and routines within a program.
3. Describe the various types of tags used within ControlLogix.
   - 3.1. Differentiate between Base, Alias, Produced and Consumed tags.
   - 3.2. Describe the difference between controller-scope tags and program-scope tags.
4. Describe the various data types associated with base tags.
   - 4.1. Differentiate between BOOL, SINT, INT, DINT and REAL data types.
   - 4.2. Differentiate between TIMER, COUNTER, and CONTROL data types.
   - 4.3. Describe the use of arrays within tag data types.
   - 4.4. Describe structure-type tags.
   - 4.5. Describe user-defined tags (UDT's), which are also referred to as user-defined structure-type tags.
5. Describe and interpret real-world I/O addresses.
   - 5.1. Describe how tags are created for local and networked I/O modules.
   - 5.2. Describe the various types of data associated with real-world tag addressing.
6. Choose the appropriate type of task execution and configure tasks.
   - 6.1. Determine the appropriate type of task execution.
   - 6.2. Configure task execution.
7. Connect a PC to a PLC.
   - 7.1. Determine which operations require a personal computer to be connected to the PLC.
   - 7.2. Describe the components required and the proper steps to follow in order to establish a communication link between a PC and a PLC.
8. Configure I/O in a project.
   - 8.1. Create a new project file.

Employer Engagement


External Data
Topic Resources
Job Descriptions
DACUM Comp.
WFD Demand
Employer RT
Corp. Faculty
Job Classifications
Maintenance Mechanic
Electrician
Machine Setup
Delivery of Product
Credit Cert/Degrees
2 Yr. AAS, ATS, AIS
One-year Cert.
Gainful Empl. Cert.
Apprenticeships

Ind. Automation Maint. Cert.
Industrial Elect. Cert.
Industrial Maintenance Degree
Automation Cert.
Industry Technical Topics
Basic Electrical
Handtools
Powertools
Ind. Safety
Pneumatics
Hydraulics
Mech Print Read
Motor Control Cir
Motors & VFDs
PLC Basics
AB CompactLogix
AB ControlLogix
Ethernet basics
Rigging
Pumps
Pipefitting basics
Machine Repair
Technical Courses
IND120 IE1
IND121 IEII
IND223 M&C
PLC200 PLCI
IND134 IFPI
Short Term Public Classes
Students come to the college
4 hr. to 24 hr. courses
Credit or N/C
AB PowerFlex 525 VFDs
Contract Training
Students come to the college
College delivers at company
4 hr. to 24 hr. courses
Credit or N/C

AB PowerFlex 525 VFDs
Intro to AB ControlLogix
Types of Students
Incumbent
Emerging
Displaced
Underemployed
Technical Courses

Engaging Employers

- How does the Technology division at NorthArk engage employers?
- Accrediting bodies like a comprehensive employer engagement strategy
- Purpose of an Advisory Board
- Purpose of an Industry Roundtable
- Purpose of a Focused Industry Visit
- Industry Consortiums (Adv. Mfg. Consortium & Lean Mfg. Consortium)

Getting Input from Employers:

Oversight Group: At some colleges this would be an Advisory Board for a program. The BILT model was implemented at Terra State CC in Ohio. This group is like a steering committee for their technical curriculum.

Technical Topic Roundtables: Our project team found the best way to get input on a topic such as the content of a PLC course, or a fluid power course, is to hold an industry roundtable. This consists of 3-4 SMEs in a 45-minute Zoom meeting. An outline is sent to each 1 week ahead of time, consisting of no more than a 2-page outline of topics that will be reviewed. Input is documented, then sent back out to the small group for their final review. A special focus should be on the hands-on skillset that is required. The nice thing about using Zoom, is the college can do a one-on-one meeting with an SME if they cannot get to the Zoom meeting. Most of all, respect their time and thank them for their input.

Communicate the results of the Roundtable back to the Oversight Group and explain how the curriculum will be adjusted to improve effectiveness and/or access.

Importance of an External SME group

- SME stands for Subject Matter Expert
- 4-6 of these SMEs should be identified to vet information through as part of the development process
- It is important to have all knowledge and skills development, align to the workplace
- This will be done through validated competencies, and measurable outcomes

Converting Existing Technical Courses to a CB/H Model

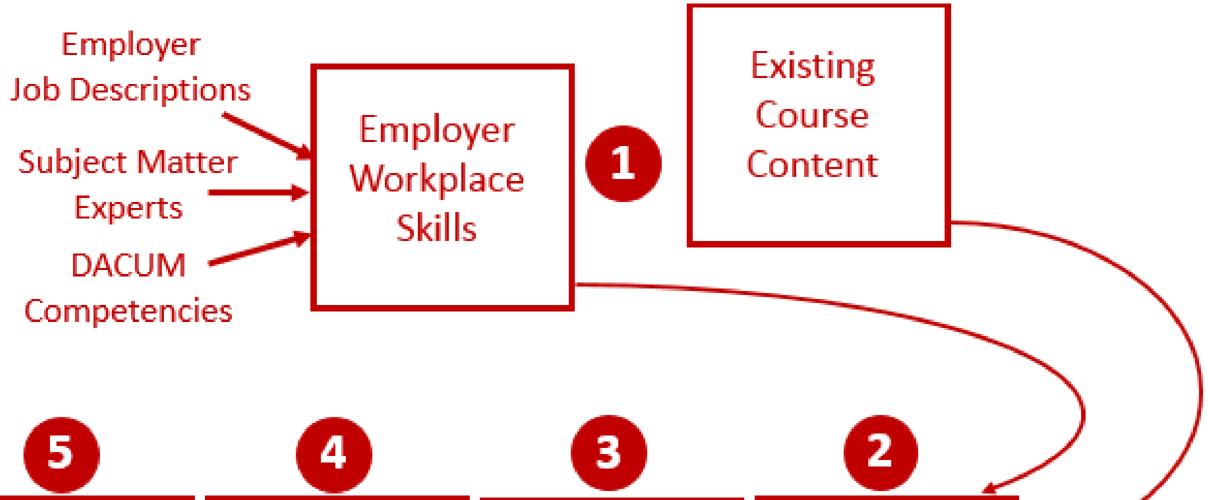
Course Blueprint when Designing a Course:

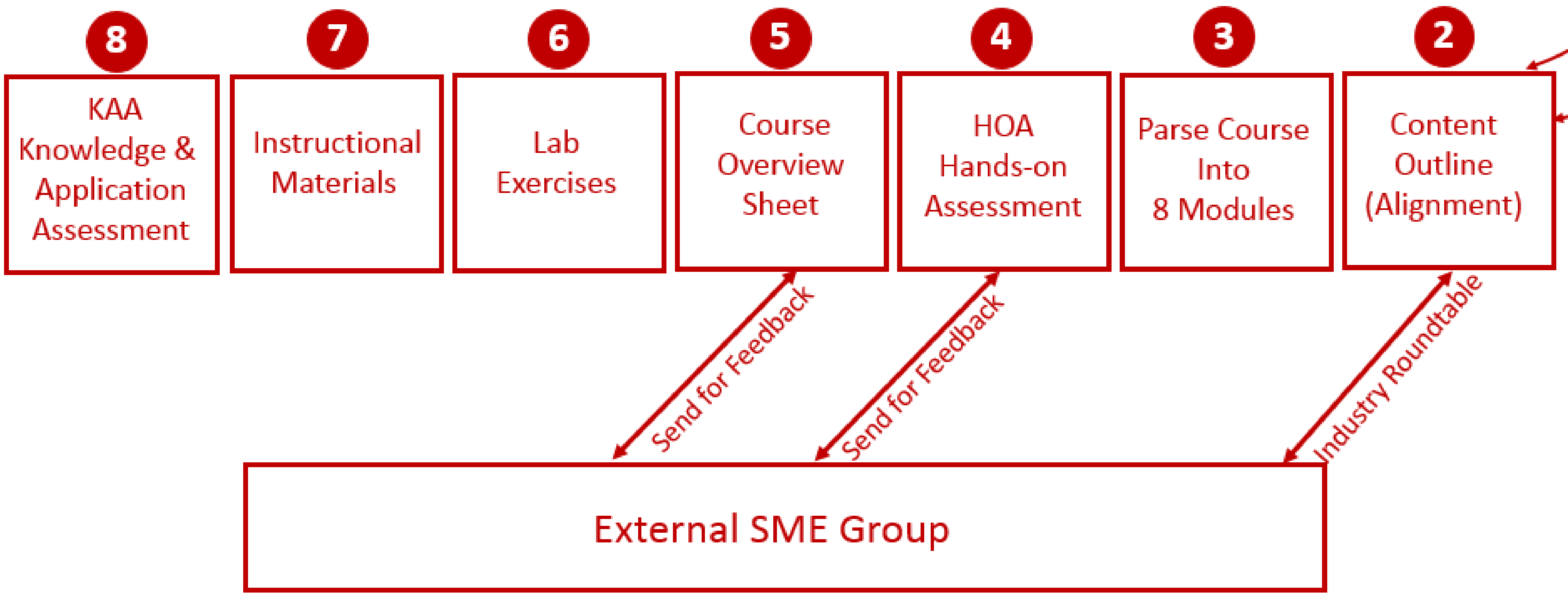
One thing I started doing a few years ago when converting/creating a technical course, was to create a Course Blueprint. This is similar to a Master Machinist needing a blueprint of a part, before they machine it.

The course is parsed into 8 modules, and I put notes, links and pictures that relate to the module into the blueprint. Basically, I am storing the information that I will be putting into Canvas in the Blueprint, such as module descriptions, outcomes, etc.

Reverse Design:

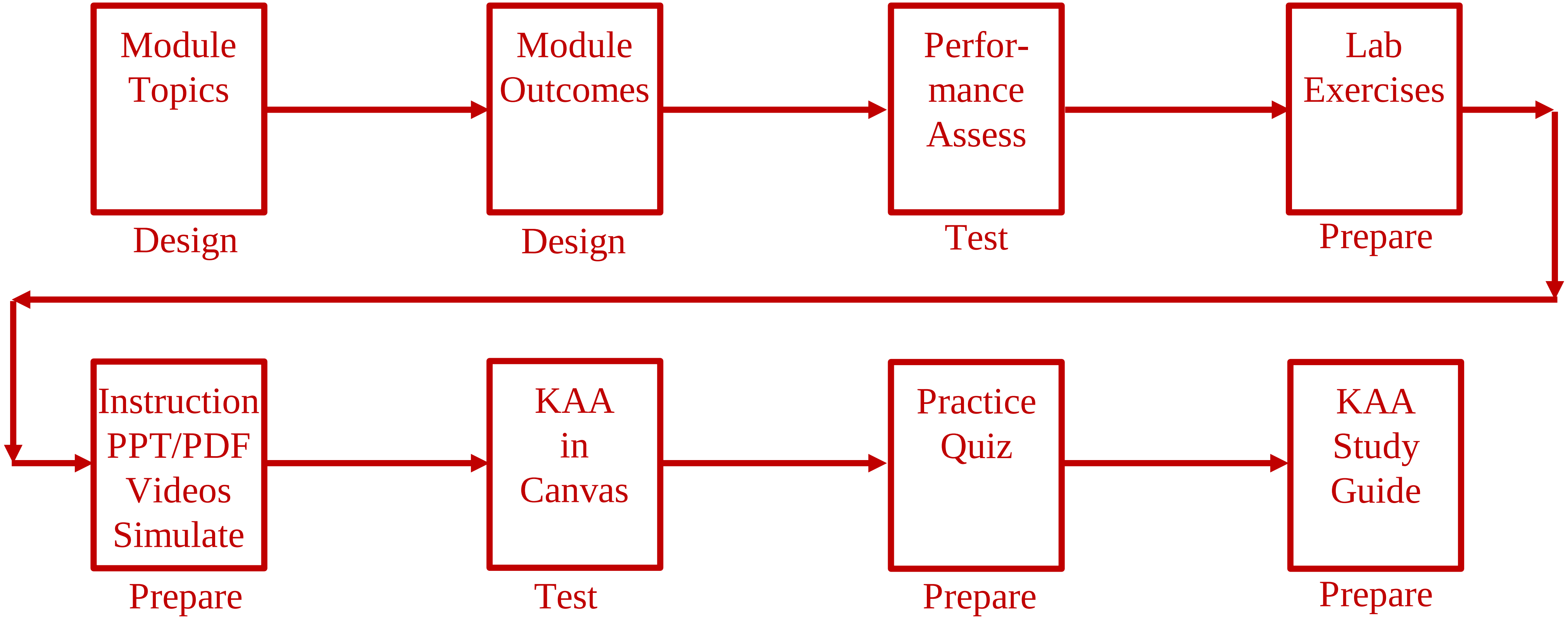
It is best to initially run the course in a standard format, to establish the correlation between content and credit/contact hours. This establishes baseline data for the cross walk between competencies and credit/contact hours.





Developing the Content of a Module:

Competency for a Module



Competency, Outcomes, Assessment & Knowledge

Competency: Use RSLinx to establish communications between a computer (with PLC programming software) and Allen Bradley PLCs (L5000, SLC-500, PLC-5 & ML1000).

Module Outcomes:

1. Configure RSLinx to communication with a ControlLogix 5571 controller.
2. Identify all the hardware components on a L5571 controller

Skills Assessment:

1. Create an Ethernet driver in RSLinx to communicate with a 1756-ENET module.
2. Create an Ethernet/IP driver in RSLinx to communicate with 1756-ENET module.
3. Create a USB driver in RSLinx to communicate with the controller.

Knowledge Required:

1. What is an IP address? What is a subnet mask? How does an Ethernet port get an IP address?
2. How to determine the IP address of a 1756-ENET module
3. How to drill down to a controller from a driver in RSLinx
4. How to use RSWho to view the drivers and communications within a ControlLogix system
5. How to create a driver in RSLinx

Prepare the Students:

Build the Instructional Material: Module Outcomes:

1. Reading assignments if using a textbook, or vendor manuals
   a. This could be the Rockwell Getting Results from RSLinx manual, or textbook

2. Create focused PPT/PDF materials focused on NorthArk lab equipment
   a. This could be pictures of the communication ports on the computer and on the PLCs in the lab and explain

3. Instructor created videos explaining hardware, or how to use software (screencam)
   a. Instructor will use Canvas, Camtasia or Zoom to record a screencam video on how to create the drivers in RSLinx

4. Created lab exercises (instructor guides the student learning)
   a. This document will go through setting up communications and ask the student questions about it

5. Create simulations in the virtual machines
   a. This can be done using the emulators in a VM, and setting up RSLinx to establish communications

Contact Hours per week for a Course:

Hours in Class, and Out of Class, in Ohio:
1 Lecture hour/week is 1 Credit Hour. 1 Lecture Hour requires 2 hours of out of class time per week.
2 Lab hours/week is 1 Credit Hour. 2 hours of Lab per week requires 2 hours of out of class time per week.
3 Lab hours/week is 1 Credit Hour. 3 hours of Lab per week requires 3 hours of out of class time per week.

ET 2440 Industrial Control Systems:
2 Lecture hour/week is 2 Credit Hour. Requires 4 hours of out of class time per week, for a total of 6 hours/week
6 Lab hours/week is 2 Credit Hours. Requires 6 hours of out of class time per week, for a total of 12 hours/week
This course should take 18 hours per week by standard academic hours.

The Learning Sequence Sheet found in each course module should show the estimated time per week to complete this module. This will be important to the Students, Academic Leadership, and for Academic Affairs.

HOME4TECHS
Hands On Maintenance Education 4 TECHnicianS

Learning Sequence Sheet:

Course Number and Title:	EET 2440 Programmable Controller I
Module # and Topic Title:	Module #2: AB SLC-500 and RSLogix 500 Basics
Semester:	Any – Last updated – 7/16/23

ACTIVITY	DESCRIPTION	TIME ON TASK	POINTS
Learning Activity	* Instructional Material: M2 RSLogix 500 Basics 111222.pdf * Video: Finding an I/O Module Wiring Terminal Diagrams 112722 * Assignment: Find SLC-500 discrete I/O module wiring diagram * Video: Creating an RSLogix500 Project for Lab 2.2 122822 * Video: Adding symbols and descriptions to an SLC 500 project 122822 * Video: Creating lab 2.3 project with symbols 120622 * Video: Lab 2.3 operation of the program 120622 * Instructional Material: Review 1st-Review 1st-NWSCC (Remote) Virtual Machine access * Video: 7 Videos on how to use NSCC VMs * Link to SLC-500 Modular Processor Diagnostic Indicators * Video: Clearing an I/O Module fault on SLC-500 122322 * Video: Replacing a Discrete IO Module on an SLC-500 Chassis 122422	Est. TOT **13.0 Hr.**	

Learning Sequence Sheet:

KAA	KAA Study Guide for Module 1 KAA Practice Quiz for Module 1 KAA for Module 1	Est. TOT **5.0 Hr.**	Min. of 80%
Lab Exercise	Lab Exercise 2.1 Finding a Discrete IO Wiring Terminal Diagram 112822.pdf	Est. TOT **2.5 Hr.**	
Lab Exercise	Lab Exercise 2.2 Getting Started with RSLogix500 Lab 122922.pdf	Est. TOT **2.5 Hr.**	
Lab Exercise	Lab Exercise 2.3 SLC-500 Basic Relay Instructions Lab 120522.pdf	Est. TOT **2.5 Hr.**	
Lab Exercise	Lab Exercise 2.4 SLC-500 Hardware Lab 122422.pdf	Est. TOT **2.5 Hr.**	
Hands-On Assessment	Hands-On Assessment	Est. TOT **2.0 Hr.**	Min. of 100%
TOTAL		**Approx.** **30 Hrs for the Module**	Approx. 15 hrs. per week

Common Elements of a Learning Module:

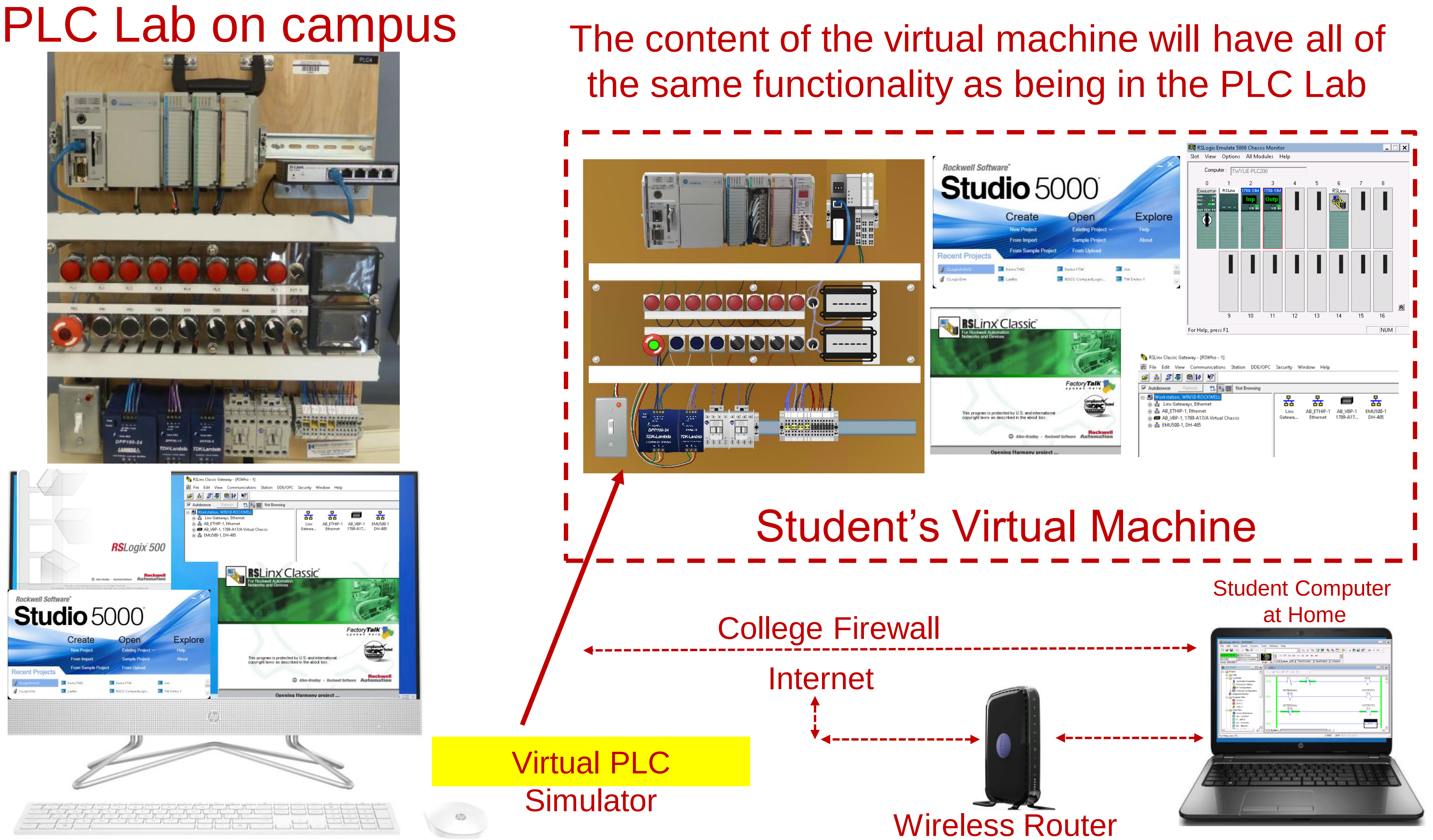
1. Module Description & Outcomes
2. Learning Sequence Sheet
3. Instructional Materials (PDFs, Videos, Reading Material)
4. Lab Exercises
5. KAA Study Guide
6. KAA Assessment
7. Practice Quiz
8. Skills Assessment

Virtual Machines & Simulations:

A virtual machine is a virtual computer that resides on the college servers, which can house proprietary software (PLC, CAD, CAM, etc.), and can be accessed by the students from home with a computer and WiFi connection, using a browser, such as Chrome, Edge, Safari or Firefox.

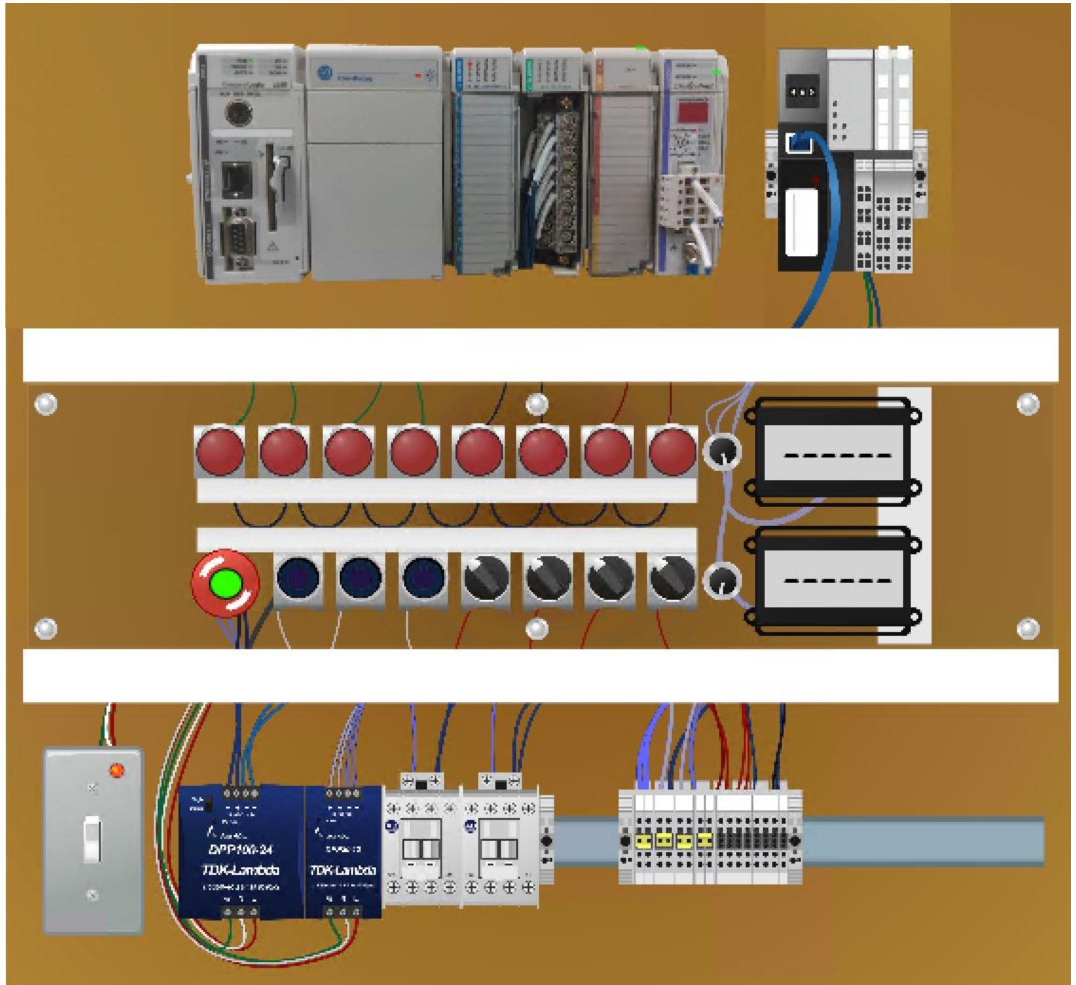
Simulations are usually created using Automation Studio, a simulation software created by Famic Corporation in Quebec.

Simulations do not replace the hands-on, but will be used to prepare students to do the hands-on learning.

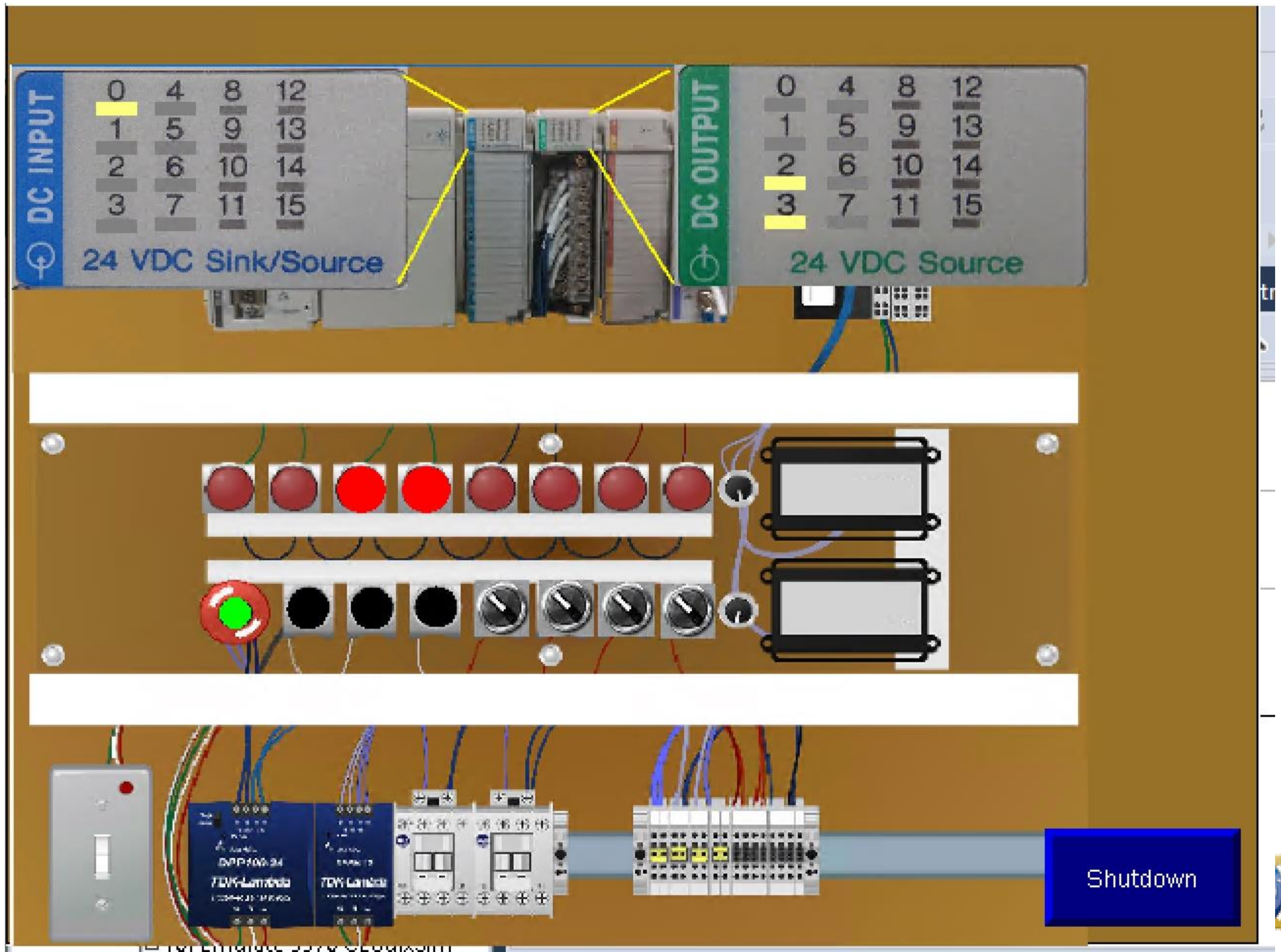

PLC Lab on campus
The content of the virtual machine will have all of the same functionality as being in the PLC Lab
Rockwell Software
Studio 5000
Create
Open
Explore
Recent Projects
RSLinx Classic
RSLogix Emulate 5000 Chassis Monitor
Student's Virtual Machine
RSLogix 500
Student Computer at Home
College Firewall
Internet
Virtual PLC Simulator
Wireless Router

The Virtual PLC Simulator, enhanced with Factory Talk View Studio, which will allow the unit to communicate with the Studio 5000 Emulator with FactoryTalk Linx. This will allow students to run their programs on the simulator that were created in Studio 5000

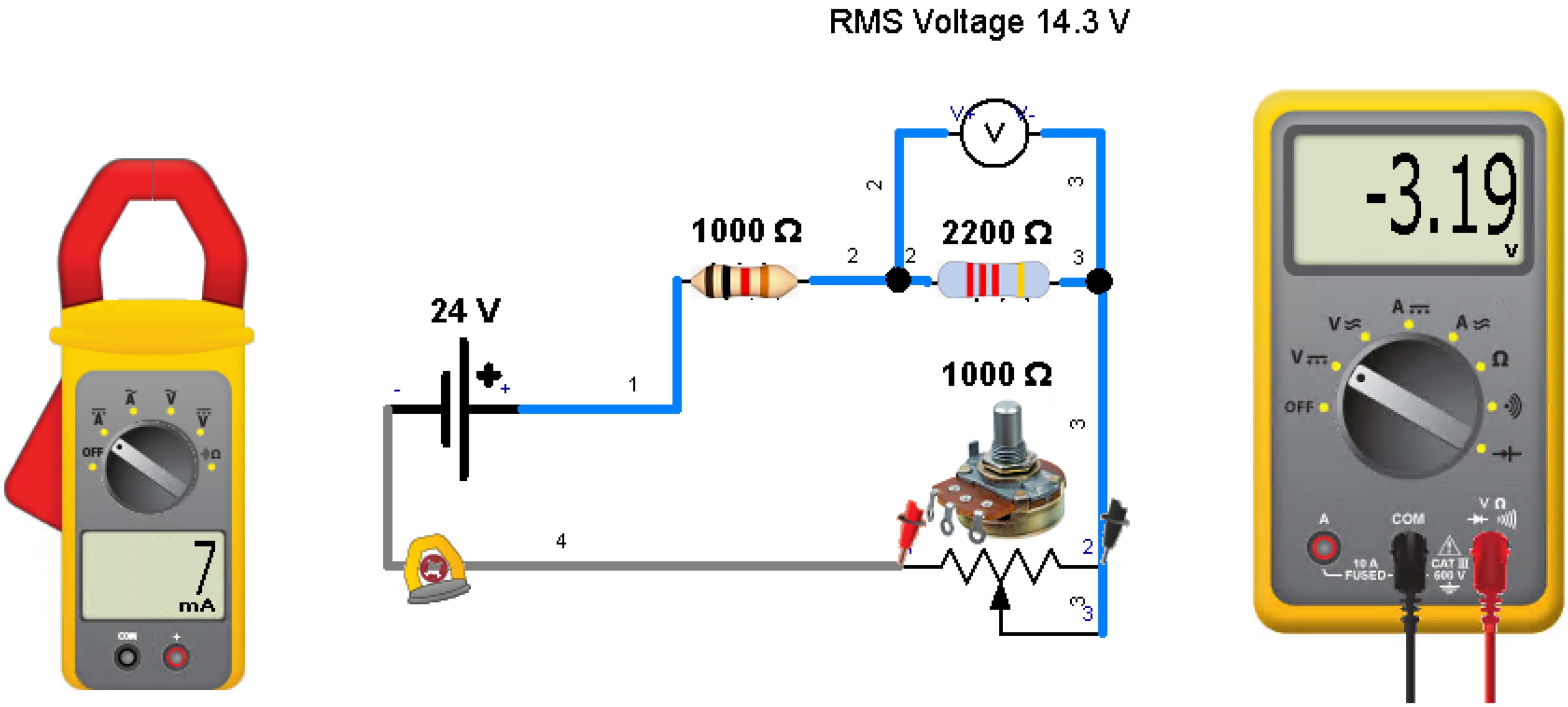
Virtual Simulator



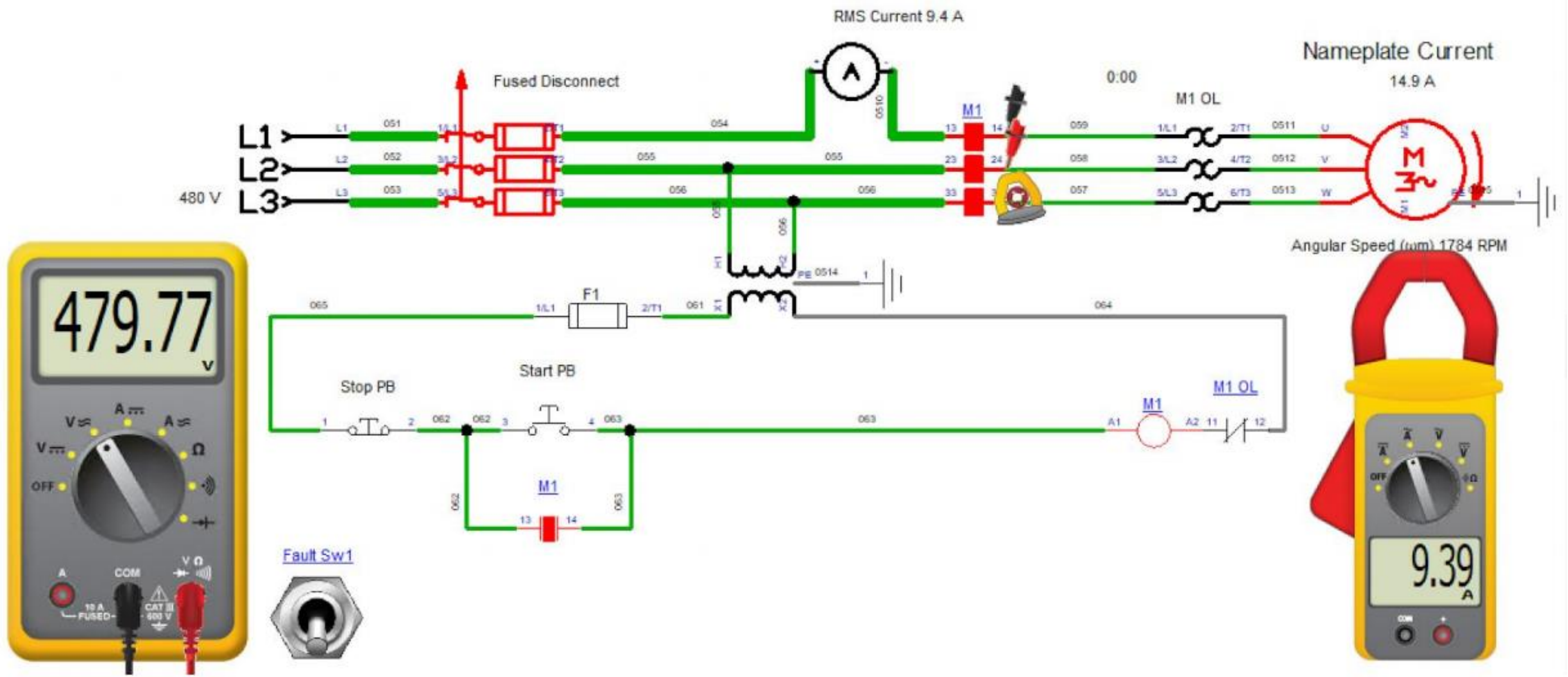
Customized Virtual Simulator



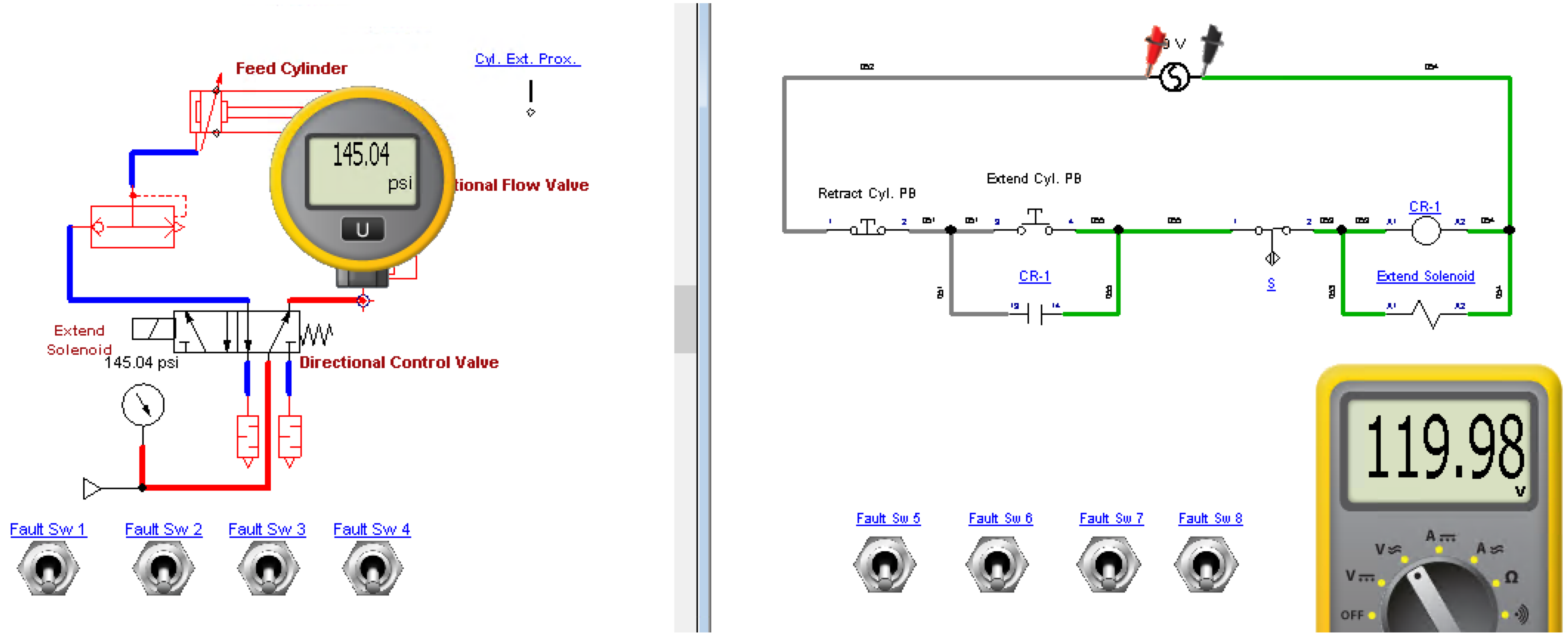
Simulation in Automation Studio for basic electrical course. Multi-meter or clamp-on ammeter can be used for testing the circuit.



Simulation in Automation Studio of a motor branch circuit.
Students see how the control circuit and power circuit works.
ault switch is used to open a power line for student troubleshooting.



Simulation in Automation Studio of an electrical circuit, controlling a pneumatic circuit. Faults are inserted for student troubleshooting. This slide show a virtual pressure gauge, and a multi-meter used to troubleshoot the pneumatic and electrical circuits where faults can be inserted from the fault switches.



Open Education Resources (OER):

OER is open material for anyone to use for instruction

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