

Going Cloud Native in your Virtualization Course

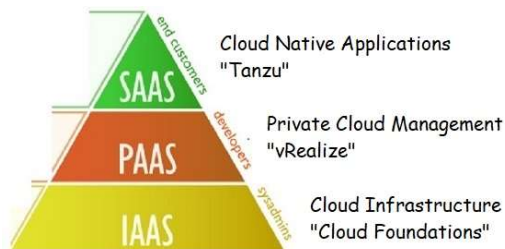
I think you will agree that **Public Cloud Services (PCS)** play a very important role in today's IT infrastructure. For this reason, it's important that our IT curriculums lay a foundation in Virtualization and Cloud computing concepts and skills that students can build on. Since Cloud Computing is closely linked to Data Center Virtualization, a virtualization course is a natural place to introduce students to cloud computing concepts and products. From here they can take more specialized Cloud certification courses using material such as Jill West's CompTIA Cloud+ Certification.

In my recent Cengage **2022 Virtual Computing Experience** presentation entitled "Clouds in the Cloud, VMware's Forecast", I discussed what cloud computing is today, how we got here, and VMware's forecast for where Cloud computing may be heading. In that session I described how VMware has been involved in the development of cloud computing technology and products that allow customers to utilize this powerful platform to grow their virtual data centers.

VMware Clouds within the Cloud Strategy

VMware is building their cloud offerings upon their popular vSphere and vCenter platform. This means that what students learn about vSphere and vCenter from our current "**Hands-on Virtual Computing**" textbook and MindTap material, will provide the foundation needed to learn about the new cloud-based infrastructure including Cross Cloud Architecture and Cloud Native applications using Docker Containers and Kubernetes clusters. These concepts fit very well into a virtualization course as described in this article.

As described in my recent Cengage VCCE presentation, I have divided VMware's Clouds in the Cloud strategy into three categories: (1) Cloud infrastructure, (2) Private Cloud management; and (3) Cloud Native Applications. These three categories of cloud services can be generally mapped into the cloud service pyramid as shown below:

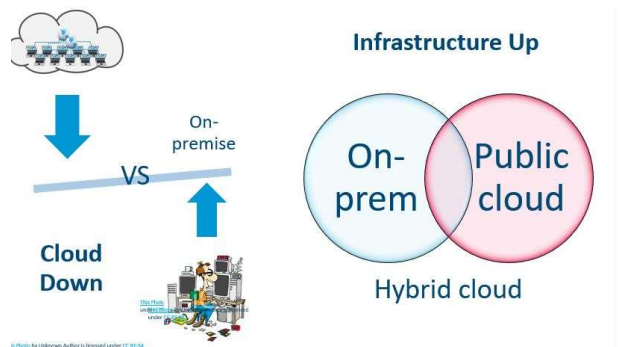


I feel it is important for a virtualization course to introduce students to the concepts and products that make up this cloud service pyramid. Students will better understand these cloud service levels when they can relate them to actual products they have experienced. While other companies such as Microsoft, Oracle, and AWS provide similar services, in my experience

VMware has the most resources to teach these concepts. In addition, VMware's large market share can also help the student's employment opportunities.

1 - Cloud Infrastructure

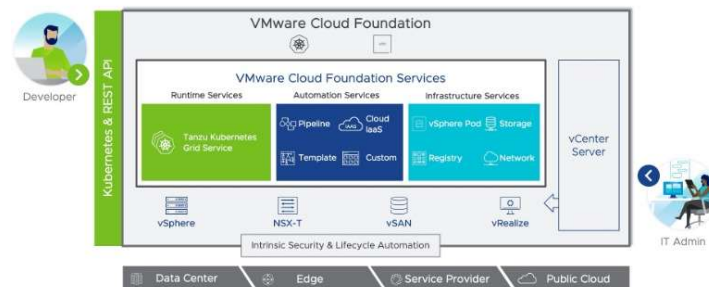
Cloud infrastructure is the base of the cloud service pyramid, and as cloud services have matured, many organizations are starting to move some or all their on-premises data center to a cloud-based model. This is happening in two ways called Infrastructure Up and Cloud Down.



Infrastructure Up, also referred to as a Hybrid Cloud, uses the public cloud services to extend the existing data center or private cloud environment. This strategy is employed by many larger organizations that have a large investment in their on-premises data center and legacy applications.

The **Cloud down** strategy replaces the on-premises data center with a cloud-based infrastructure. This strategy is perhaps most popular with smaller startup organizations or with companies that offer Web services and products.

VMware's answer to Cloud infrastructure is their **Cloud Foundations** product which allows an organization to host their virtual data center on a public cloud such as AWS, Microsoft Azure, or IBM Cloud. Cloud Foundations is based on VMware's Software Defined Data Center model which uses such products as VMware NSX and vSAN to hyperconverge all data center resources and then manage that environment from vCenter as shown below.



Using Cloud Foundations an organization can employ either the Infrastructure Up or Cloud Down strategy depending on their needs. VMware offers several Cloud Foundation products

including “VMware on AWS” for use on Amazon Web Services, and “Azure VMware Solution” for use with Microsoft Azure.

The concepts students need to understand Cloud Foundation concepts and products are introduced in our Hands-on Virtual Computing book, making it relatively straight forward to include these products in your virtualization course as I will show later in this article.

2 - Private Cloud Management

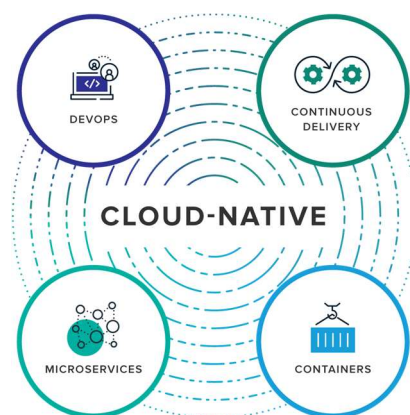
Many organizations that have an on-premises data center often wish to host cloud-based services within their own local network rather than “farming” them out to Public Cloud Service providers. VMware provides for creating and managing private cloud infrastructure through their **vRealize** product line. Chapter 10 of our Hands-on Virtual Computing book introduces students to vRealize private cloud concepts as well as the Microsoft Azure public cloud.

3 - Cloud Native Applications

In addition to upgrades to their virtualization infrastructure products, VMware has spent many millions of dollars acquiring multiple companies that specialize in Container and Kubernetes products and services. Among these acquisitions are **Bitnami**, a leading provider of prepackaged container applications that run natively on Kubernetes, and **Pivotal**, an open-source DevOps application development and management platform.

In my recent “Clouds in the Cloud – VMware’s Forecast” presentation, I provided an overview of what Docker containers are and how they fit into Cloud Native environments. In this article I want to start by providing a brief overview of what I feel students should know about these concepts to better understand the VMware products used to build and manage Cloud Native application structures.

Cloud Native application have the following 4 characteristics:

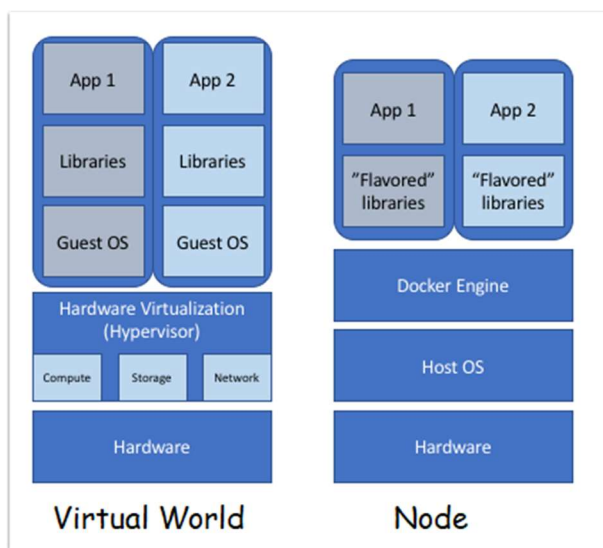


As compared to a specific technology or product, **DevOps** and **Continuous Delivery** are more of a team-based methodology for developing and updating applications on a continuous basis as compared to having major releases and upgrades. DevOps and Continuous Deliver is best

implemented using **Microservices**. In the traditional or monolithic application development process, the monolithic application consists of many software objects that are compiled into a one or more large applications that are then run on a data center server or virtual machine. Making changes to one of the objects in a monolithic application involves re-compiling and releasing an entire new application. Microservices on the other hand are independent entities that can be developed, updated, and tested individually. A Cloud Native application typically consists of multiple Microservices.

Docker Containers

While a microservice can be run on a virtual machine, the virtual machine has a lot of overhead including the Hypervisor, complete guest OS, application code and libraries. All this overhead makes running a Microservice on a virtual machine cumbersome and resource intensive. To solve this problem, Containers were developed. As shown below, a **Container** is a virtual environment that “contains” the microservice application code along with all its dependencies.



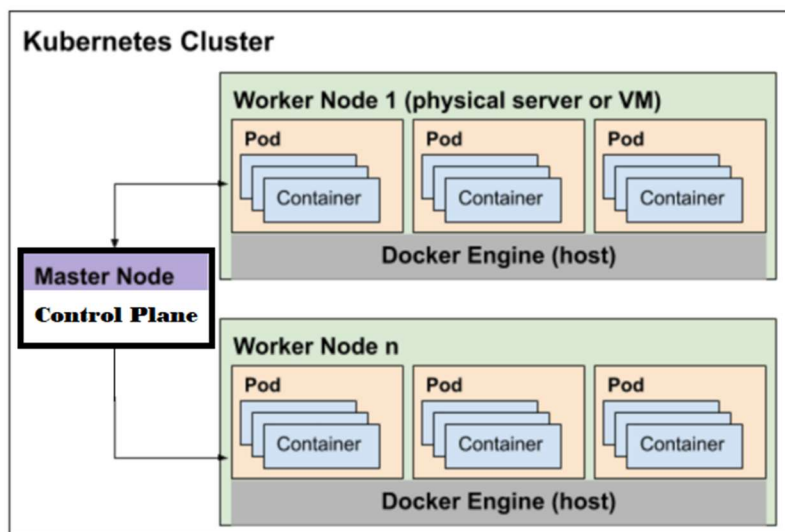
A container, like a virtual machine, requires a hypervisor layer (such as a Docker Engine or Daemon) to connect the container application to the host computer. This is where Docker comes in. Docker is an Open-Source Container development package that allows the software engineer to compile the Microservice along with its dependencies, storing the application package in a registry. Docker also includes a Daemon (hypervisor) that allows the Container to be “plugged” into a Linux OS and run as an independent entity. You can see from this that we can draw a very close relationship between a Container and Virtual Machine. In this way, teaching Container technology in a virtualization class makes a lot of sense. Since containers are a lot like virtual machines, we can show that Docker is very similar to vSphere. What a great way for students to understand both concepts!

Because Docker is open-source, VMware and Microsoft both provide Docker Engines for their hypervisors. This means a Container can be moved between Linux, Hyper-V, or vSphere with not changes. The problem with Docker is that it is designed to work with one Container at a

time. Since Cloud Native applications consist of many Microservice based Containers, dealing with each container separately would make managing large applications very inefficient.

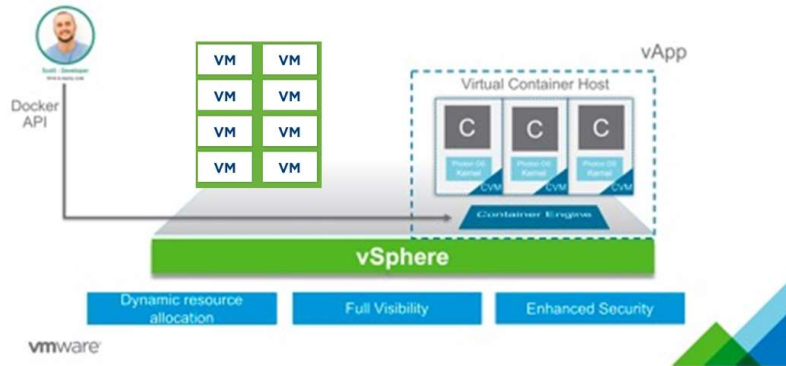
Enter Kubernetes!

Like Docker, **Kubernetes** is an open-source package that is designed to manage large applications consisting of many Microservice based Containers running on Docker engines. As shown below, Kubernetes breaks Containers into Pods consisting of one or more containers. You could think of a Pod as a Cloud Native Application consisting of multiple Microservices (Containers). A Worker Node is a computer or virtual machine that hosts one or more pods running on a Docker engine (Hypervisor). The Master Node is the control pane running on a separate computer or Virtual Machine. All Pods and Worker Nodes can be managed for the Control Pane.



You can think of Kubernetes as similar in function to the vCenter server. Just as vCenter Server manages multiple vSphere hosts in clusters, Kubernetes manages Nodes containing Pods. For this reason, learning vCenter Server can help the student understand the concepts behind Kubernetes.

In the last few years, VMware has introduced several products to bring Containers and Kubernetes into the vSphere world. The first (shown below) is vSphere Integrated Containers (VIC), released in 2016.



VIC takes advantage of the Docker Open-Source license to build the Docker Dameon into the vSphere hypervisor. VIC requires vSphere 6.5 and allows containers to be managed in the same way as Virtual Machines. This is a great way to manage individual container but does not solve the issue of managing large Native Cloud applications such as Kubernetes. An effective activity is to have students use the vSphere Client to manage containers. I will be posting such an activity to www.tedsimpsonbooks.com this summer.

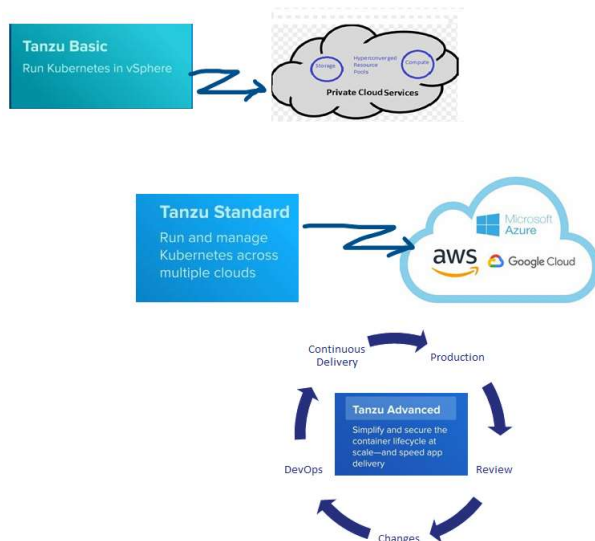
VMware's answer to using Kubernetes is called **Project Pacific**. Project Pacific has two major components: vSphere 7, and Tanzu.

vSphere version 7

On the surface, vSphere 7 appears much the same as the vSphere 6.0 we use in our Hands-on Virtual Computing textbook and MindTap. However, looks are deceiving, as this is a major rewrite of vSphere. vSphere 7.0 has been re-designed to be a player in the Kubernetes world and can be either a Kubernetes Control Plane or a Kubernetes work node. While vSphere v7 is very similar in function to the vSphere v6 used in the textbook, the steps to perform many functions have changed making the activities in the textbook to longer work as written. The MindTap activities work as written as they are using an image that contains vSphere v6. If you would like students to work with vSphere 7, I have written a Kindle eBook (VMware vSphere 7.0 Companion) that has all the activities re-written for vSphere 7. You can download all the updated vSphere 7 activities in PDF files from my www.tedsimpsonbooks.com Web site. While our MindTap Live Virtual Machine labs work with the vSphere v6, they still can be used to provide students with the concepts they need to work with a virtual data center or cloud environment.

Tanzu:

The word "Tanzu" in Swahili means branch or the part of a tree arising from the trunk. This definition fits the product, as Tanzu is a way to branch out from vSphere into the Cloud Native world of Kubernetes and Docker. There are three editions of Tanzu as shown below:



The Tanzu Basic edition is used to run off the shelf cloud native container applications such as those found on Bitnami on a private network. The Standard version takes this capability to the public cloud allowing management of Kubernetes Cluster across multiple cloud environment. Advanced Tanzu uses technology from the Pivotal to provide developers the tools needed to create and update Microservice based applications on the Kubernetes platform.

Implementing Cloud technology in your Virtualization Course

As you can see, there is a lot going on at VMware relative to Cloud Services.

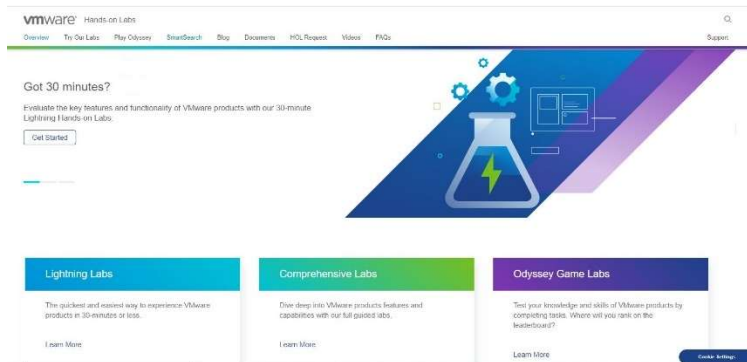
The challenge is how to spice up your Virtualization course by introducing students to some of this exciting Cloud technology. For starters, our **Hands-on Virtual Computing** textbook or MindTap material covers all the fundamental concepts the new Cloud products are built on and therefore is still an excellent base for a revitalized virtualization course. The textbook covers vSphere and Hyper-V hypervisors, Virtual Machines, vCenter Server, Clustering, vRealize private clouds, and hyperconvergence of networks and storage.

What we need to do is find a way to add this new material to cover the cloud concepts I mentioned earlier as well Cloud Native or Project Pacific activities. To do this means finding resource material as well as time in the course schedule. While I am working with Cengage to create an updated digital MindTap edition of Virtual Computing in the future, this will not be ready for the 2022-23 school year.

In this article I want to identify some resources you can use in your course as well as a sample 16-week course schedule and will include time for VMware's Cross-Cloud architecture and Cloud Native support.

VMware Hands-on Labs

I feel hands-on activities are essential for students to learn new skills, and the best source of Hands-on Activities for the latest VMware products is VMware's Hands-on Lab environment. In 2021 I did a VCCE presentation on Using VMware Hands-on Labs in your classes. For a more detailed description of using this resource please review my presentation: ([presentation link here?](#)). You can go to VMware Hands-on Lab by entering the URL: HOL.vmware.com (in my experience it seems to work best when using Chrome as the Web browser), to display the home page as shown below.

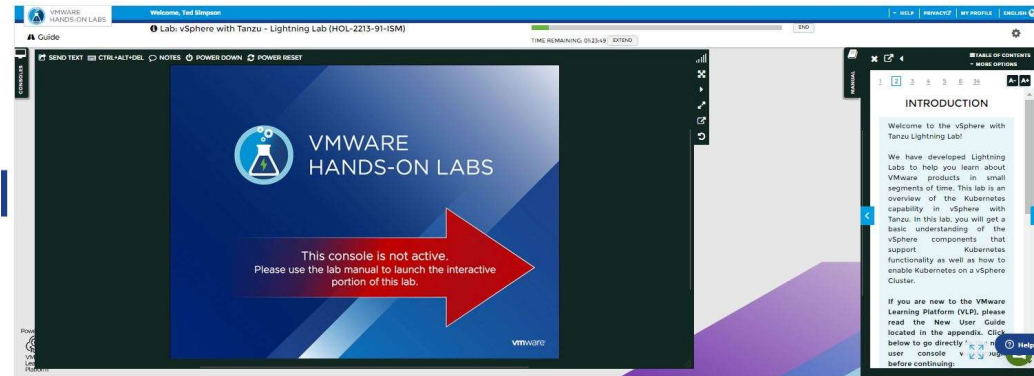


Notice that there are 3 types of Labs: Lightning Labs, Comprehensive Labs, and Odyssey Game Labs. Lightning Labs are best for an introductory course as they provide an overview (about 30-40 minutes each) of using a product without getting in too deep. To view Lightning Labs, scroll down and click the **Get Started** button from the Lightning Labs page to display the Lightning Labs list. Note that you will need to click the Log In link from the menu bar to login or if necessary, create a new account. You can then browse through the Lightning Labs. (A detailed description of using VMware Hands-on Labs is provided in my "Introducing Digital Business Technology Solutions").

I believe the following Lightning Labs would work well in a Virtualization course.



To start a lab, click the **Start** link and follow the instructions to see the lab screen shown below for the vSphere with Tanzu lab.



The console is shown in the left-hand frame with the instructions for the activity in the right-hand Manual frame. Students can follow the instructions in the Manual to learn about the product and perform the required tasks in the left-hand console frame. You may want to ask them to answer certain questions as they go through the lab to help them focus on what they are doing.

Kindle Resource Materials

While students can lookup information on products and technology using VMware’s Web page, this can be a rather daunting task. For that reason, I am in the process of developing some short Kindle eBooks that focus on certain VMware product categories. I like to think of these Kindle “Booklets” as similar to “Microservices” in that they are short and focused on a specific topic or product. With all the changes going on in the industry, I can keep short eBooks like these relatively up to date much easier than a full textbook. My Kindle eBooks use VMware Hands-On labs to provide the student with practical hands-on experience with specific products. The eBooks are also available in printed form which allows students to take notes in the printed book as well as write answers to specific lab and review questions. My first eBook published this Winter is shown below:

Introducing VMware Digital Business Transformation Technologies



- **Introduces VMware technologies and products including Clouds in the Clouds topics used in this presentation**
- **Covers using VMware Hands-on Labs and eLearning sites**
- **Overview of VMware 2022 Certifications**
- **eMail me for a free eBook:**
 - tsimpson@tedsimpsonbooks.com
- **Web site: TedSimpsonBooks.com**

The “Introducing VMware Digital Business Transformation Solutions” eBook describes current VMware DBT products including Cloud Foundations and Project Pacific. In addition, the eBook has a chapter on using Hands-on VMware labs as well as a chapter on VMware’s 2022 certifications. I believe the “Introducing VMware Digital Business Transformation Solutions” material would make a good addition to Chapter 1 of the Hands-on Virtual Computing as well helping students use my upcoming eBooks. If you are currently using my Hands-on Virtual Computing text, email me at “TSimpson@TedSimpsonBooks.com” or connect with me on Facebook to obtain a free PDF file of this eBook and activities. I think you will find it contains useful information to help extend your virtualization course (see outline below).


Building Cloud Native into your Virtualization Course

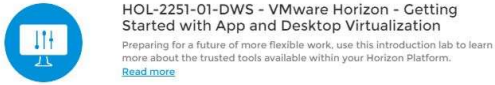

The following diagram shows how eBooks and VMware Hands-on Labs can be plugged into the Hands-on Virtual Computing text to allow you to bring Clouds in the Cloud technology to your virtualization course. As with the Introducing VMware Digital Business Transformation book, PDF files of these books are available if you are using Hands-on Virtual Computing and send me an email – tsimpson@tedsimpsonbooks.com.



The following table shows one way you might combine Hands-on Virtual Computing with VMware Hands-on Labs along with my other resource materials to form a re-vitalized 16-week virtualization course consisting of 2-hour lecture and 2-hour lab per week.

Note: In the following outline, DBT refers to my Introducing VMware’s Digital Business Transformation eBook. If you are using my Hands-on Virtual Computing text, you can download a PDF of this booklet for use in your course from www.tedsimpsonbooks.com.

Wk	Lecture Topic	Hrs	Lab Assignment	Hrs
1	Chapter 1 “Introduction to Virtualization and Cloud”	2	Chapter 1 MindTap Activities	2
2	Chapter 1 lecture Chapter 2 Oracle VirtualBox lecture	2	Chapter 2 MindTap labs Optionally have students download and install Oracle Virtual Box on their computer.	2
3	Chapter 1 from DBT book (discuss today’s DBT technologies including Cloud Native apps)	1	Students complete Oracle VB activities. Have students do the activities in chapter 1 of DBT and answer the review questions.	3
4	Chapter 3 - Discuss VMware Workstation Pro and Player	1	MindTap lab 3-1	3
5	Chapter 3 – Continue with VMware Workstation discussion. Include VMware Player from Appendix B.	1	MindTap lab 3-2 Optionally have students download and install VMware Workstation Player on their computer.	3
6	Chapter 4: Data Center Virtualization and Cloud Computing	2	MindTap Lab 4-1	1
7	Finish lecture of Chapter 4 Lecture on DBT Chapter 2 (Using VMware Labs)	2	DBT Chapter 2 Activities 2-1, 2-2 By doing these activities students will learn how to access VMware Hands-on Labs as well as experience installing and using vSphere.	2
8	Chapter 5: Microsoft Hyper-V Provide an overview of Hyper-V If you have time you can include chapter 6.	1	MindTap Labs	3
9	Chapter 7: VMware vSphere	2	MindTap Labs 7-1, 7-2, and 7-3	2
10	Chapter 7: Continue VMware vSphere discussion. Include discussion of Containers, Kubernetes and Tanzu (refer to www.tedsimpsonbooks.com for supplemental materials)	2	Have students perform VMware Hands-on Tanzu Lab shown below:  Have students submit paper on Tanzu by using VMware resources and their lab experience.	2
11	Chapter 8: vCenter Server lecture	2	MindTap labs 8-1 and 8-2	2

12	Chapter 8: Finish vCenter lecture	1	MindTap Labs 8-3 and 8-4	3
13	Chapter 9: Virtual Desktop Infrastructure lecture Lecture on VDI concepts and VMware Horizon product.	2	. (Note that there is no MindTap lab for VMware Horizon as it did not fit the Live Virtual Machine Lab image.) For VMware, have students do the following Horizons Lab: 	2
14	Chapter 9: VDI with Hyper-V	1	MindTap Lab 9-2 for Hyper-V	3
15	Chapter 10: Introduction to Cloud Computing Lecture on Cloud services and how they are implemented in Private or Public clouds. Discuss the concepts behind VMware Cloud Foundations	2	Have students perform the following lightning labs: 	
16	Chapter 10 continued Lecture on using Microsoft Azure and AWS	1	Have students perform MindTap Lab 10-1	3

I hope this discussion will ignite your interest in re-vitalizing your Virtualization course with VMware's Clouds within the Cloud strategy as well as provide you with some resources and course framework that will help you along. If you have questions or would like to discuss using my materials in your virtualization course, please email me at tsimpson@tedsimpsonbooks.com. If you would like to get information on the latest VMware and course information, signup for my Facebook page.

Thanks for taking time to look over this article and I wish you a great rest or you Spring semester!