Association Supporting Computer Users in Education
"Our Third Quarter Century of Resource Sharing"

Proceedings of the 2019 ASCUE Summer Conference
52st Annual Conference
June 9 – 13, 2019
Myrtle Beach, South Carolina
Web: http://www.ascue.org

ABOUT ASCUE

ASCUE, the Association Supporting Computer Users in Education, is a group of people interested in small college computing issues. It is a blend of people from all over the country who use computers in their teaching, academic support, and administrative support functions. Begun in 1968 as CUETUG, the College and University Eleven-Thirty Users' Group, with an initial membership requirement of sharing at least one piece of software each year with other members, ASCUE has a strong tradition of bringing its members together to pool their resources to help each other. It no longer requires its members to share homegrown software, nor does it have ties to a particular hardware platform. However, ASCUE continues the tradition of sharing through its national conference held every year in June, its conference proceedings, and its newsletter. ASCUE proudly affirms this tradition in its motto: "Our Third Quarter Century of Resource Sharing"

ASCUE's LISTSERVE

Subscribe by visiting the site http://groups.google.com/a/ascue.org/group/members and follow the directions. To send an e-mail message to the Listserve, contact: members@ascue.org Please note that you must be a subscriber/member in order to send messages to the listserve.

NEED MORE INFORMATION

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Keynote Speaker

For years from his executive post, **Chris Laping** has been engaging audiences with disruptive ideas on innovation and roller coaster storytelling. Now, he is hitting the stage as author of his debut book, People Before Things, to take audiences on a journey that focuses on how great organizations take care of people and inspire a culture of change. Whether it's a large audience at a national conference or a small, private group, Chris brings the same passion and energy to each talk—and with content that's tailored for each unique situation!

Prior to founding People Before Things, LLC, Chris served as SVP, Business Transformation and CIO at Red Robin Gourmet Burgers. In these roles, he was a highly contributing member of a management team that completed a successful turnaround, taking the company from an $8 stock price to $89 in just a few years. Chris has 27 years of technology and change leadership experience across multiple brands and industries and has been widely recognized for his innovative thought leadership. He was named a Top 5 Social Business Leader by The Economist, Social Business Technology Leader by Information-Week and Premier 100 IT Leader by Computerworld. The work of the teams he led has been spotlighted in The Wall Street Journal, Forbes, Fast Company and CIO Magazine, among others.

LEADERSHIP HIGHLIGHTS

- Based on personal leadership philosophies and experience, authored a #2 Amazon bestseller in the category of Organizational Change: People Before Things.
- Between 2011-2015: led a team that was consistently recognized through the company-wide, Team Member of the Quarter award program. On average, his Business Transformation team members held this title 75% of the time.
- Received 2014 Trace3 Outlier Award, which honors exceptional individuals who consistently deliver dynamic innovation and outstanding leadership in the field of information technology.
- Featured in various Forrester case studies—spotlighting not only successful technical implementations managed by his team, but also the collaborative models used to engage stakeholders, obtain adoption, and enable business outcomes.
- Part of a management team that led a successful turnaround of an $8 stock to $89 – in just a few years.
- The work of his teams have been spotlighted in three books: The Engaged Leader, Mobile Mind Shift, and Implementing World Class IT.

Organization for the Proceedings

ASCUE initiated a refereed track for paper submissions to the conference in 2008. In fact, at the 2008 business meeting, the membership approved three different presentation tracks: refereed with 3 blind reviews for each paper, session with paper where the author submits a paper but it is not reviewed, and session without paper where no paper is submitted and only the abstract is included in the proceedings. To reflect this division, we will divide the proceedings into three sections. The first section, up to page 60, will contain the approved refereed papers, the second section, from 61 to 79, will hold the papers from the sessions with paper, and the last section will list the abstracts for the other sessions.

ASCUE BOARD OF DIRECTORS FROM 1967 to 2017

At this conference we celebrate the 52nd anniversary of the founding of ASCUE at a meeting in July, 1968, at Tarkio College in Missouri of representatives from schools which had received IBM 1130 computers to help them automate their business functions and teach students how to use computers. They decided to form a continuing organization and name it CUETUG, which stood for College and University Eleven-Thirty Users Group. By 1975, many of the member schools were no longer using the IBM 1130, and were requesting to be dropped from the membership lists. At the same time, other small schools were looking for an organization that could allow them to share knowledge and expertise with others in similar situations. The name was changed from CUETUG to ASCUE at the 1975 business meeting and we opened membership to all institutions that agreed with our statement of purpose. Our historian, Jack Cundiff, has collected the names and schools of the officers for ASCUE and its predecessor CUETUG for the last fifty years and we have printed these names on the following pages.

ASCUE BOARD OF DIRCTORS FROM 1967 to 1972

	1967-68	1969-70	1970-71	1971-72
President				
	Ken Zawodny St. Joseph’s College	Howard Buer Principia College	Jack Cundiff Muskingum College	Wally Roth Taylor University.
Program Chair				
	Wally Roth Taylor University	Jack Cundiff Muskingum College	Wally Roth Taylor University	James McDonald Morningside College
Past President				
	Al Malveaux Xavier, New Orleans	Ken Zawodny St. Joseph’s College	Howard Buer Principia College	Jack Cundiff Muskingum College
Treasurer				
	Howard Buer Principia College	Al Malveaux Xavier University	Al Malveaux Xavier University	Al Malveaux Xavier University
Secretary				
	John Robinson	Dorothy Brown South Carolina State	Dorothy Brown South Carolina State	Dick Wood Gettysburg College
Board Members				
	James Folt Dennison University	James Folt Dennison University	James Foit Dennison University	John Orahood U. of Arkansas, LR
At Large				
	Don Glaser Christian Brothers C.	Don Glaser Christian Brothers	Don Glaser Christian Brothers	N. Vosburg Principia College
Public Relations				
				Dan Kinnard Arizona Western
Librarian				
				Jack Cundiff Muskingum College
Equip. Coordinator				
Web Coordinator				
Sponsor Relations Coordinator				
Location:	Tarkio College	Principia College	Muskingum College	Christian Brothers

ASCUE BOARD OF DIRCTORS FROM 1972 to 1976

	1972-73	1973-74	1974-75	1975-76
President	James McDonald Morningside College	Dan Kinnard Arizona Western	T. Ray Nanney Furman University	Larry Henson Berea College
Program Chair	Dan Kinnard Arizona Western	T. Ray Nanney Furman University	Larry Henson Berea College	Jack McElroy Oklahoma Christian
Past President	Wally Roth Taylor University	James McDonald Morningside College	Dan Kinnard Arizona Western	T. Ray Nanney Furman University
Treasurer	J. Westmoreland U. Tenn Martin	J. Westmoreland U. Tenn Martin	Jim Brandl Central College	Jim Brandl Central College
Secretary	Ron Anton Swathmore College	Ron Anton Swathmore College	Harry Humphries Albright College	Harry Humphries Albright College
Board Members	John Orahood U. of Arkansas, LR	Al Malveaux Xavier, New Orleans	Sister Keller Clarke College	Sister Keller Clarke College
At Large	N. Vosburg Principia College	Wally Roth Taylor University	Wally Roth Taylor University	Mike O'Heeron
Public Relations	Dan Kinnard Arizona Western	Dan Kinnard Arizona Western	Dan Kinnard Arizona Western	Dan Kinnard Arizona Western
Librarian	Jack Cundiff Muskingum College	Jack Cundiff Muskingum College	Jack Cundiff Muskingum College	Jack Cundiff Muskingum College
Equip. Coordinator				
Web Coordinator				
Sponsor Relations Coordinator				
Location:	Georgia Tech	Morningside	Furman	Berea

ASCUE BOARD OF DIRCTORS FROM 1976 to 1980

	1976-77	1977-78	1978-79	1979-80
President				
	Jack McElroy	Harry Humphries	Fred Wenn	Doug Hughes
	Oklahoma Christian	Albright College	Caspar College	Dennison University
Program Chair				
	Harry Humphries	Fred Wenn	Doug Hughes	J. Westmoreland
	Albright College	Caspar College	Dennison University	U. Tenn Martin
Past President				
	Larry Henson	Jack McElroy	Harry Humphries	Fred Wenn
	Berea College	Oklahoma Christian	Albright College	Caspar College
Treasurer				
	William Roeske	William Roeske	James Foit	James Foit
	Houghton College	Houghton College	Central Ohio Tech	Central Ohio Tech
Secretary				
	Doug Hughes	Doug Hughes	Dave Dayton	John Jackobs
	Dennison University	Dennison University	Grove City College	Coe College
Board Members				
	Dave Dayton	Dave Dayton	Jan C. King	Wally Roth
	Grove City College	Grove City College	Chatham College	Taylor University
At Large				
	Fred Wenn	John Jackobs	John Jackobs	Jan C. King
	Casper College	Coe College	Coe College	Chatham College
Public Relations				
	Dan Kinnard	Sister Keller	Sister Keller	Sister Keller
	Arizona Western	Clarke College	Clarke College	Clarke College
Librarian				
	Jack Cundiff	Jack Cundiff	Jack Cundiff	Jack Cundiff
	Muskingum College	Muskingum College	Muskingum College	Muskingum College
Equip. Coordinator				
Web Coordinator				
Sponsor Relations Coordinator				
Location:	OK Christian	Albright College	Casper College	Dennison University

ASCUE BOARD OF DIRCTORS FROM 1980 to 1984

	1980-81	1981-82	1982-83	1983-84
President				
	J. Westmoreland	John Jackobs	Jan Carver	Wally Roth
	U. Tenn Martin	Coe College	Chatham College	Taylor University
Program Chair				
	John Jackobs	Jan Carver	Wally Roth	Dudley Bryant
	Coe College	Chatham College	Taylor University	Western Kentucky
Past President				
	Doug Hughes	J. Westmoreland	John Jackobs	Jan Carver
	Dennison University	U. Tenn Martin	Coe College	Chatham College
Treasurer				
	Ron Klausewitz	Ron Klausewitz	Harry Lykens	Harry Lykens
	W. Virginia Weslyan	W. Virginia Weslyan	Mary Institute, St L.	Mary Institute, St. L.
Secretary				
	Jan Carver	Ken Mendenhall	Ken Mendenhall	John Jackobs
	Chatham College	Hutchinson CC, KS	Hutchinson CC, KS	Coe College
Board Members				
	Dudley Bryant	Dudley Bryant	William Roeske	William Roeske
	Western Kentucky	Western Kentucky	Houghton University	Houghton University
At Large				
	Wally Roth	Chuck Mcintyre	Chuck Mcintyre	Bob Renners
	Taylor University	Berea College	Berea College	Kenyon College
Public Relations				
	Sister Keller	Sister Keller	Sister Keller	Sister Keller
	Clarke College	Clarke College	Clarke College	Clarke College
Librarian				
	Jack Cundiff	Jack Cundiff	Jack Cundiff	Jack Cundiff
	Muskingum College	Muskingum College	Muskingum College	Muskingum College
Equip. Coordinator				
Web Coordinator				
Sponsor Relations Coordinator				
Location:	U. Tenn Martin	Coe College	Chatham College	Taylor University

ASCUE BOARD OF DIRCTORS FROM 1984 to 1988

	1984-85	1985-86	1986-87	1987-88
President	Dudley Bryant Western Kentucky	Paul Pascoe Vincennes University	Jack Cundiff Horry-Georgetown	Keith Pothoven Central College
Program Chair	Paul Pascoe Vincennes University	Jack Cundiff Horry-Georgetown	Keith Pothoven Central College	David Cossey Union College
Past President	Wally Roth Taylor University	Dudley Bryant Western Kentucky	Paul Pascoe Vincennes University	Jack Cundiff Horry-Georgetown
Treasurer	Harry Lykens Mary Institute, St. L	Harry Lykens Mary Institute, St. L	Maureen Eddins Hadley School Blind	Maureen Eddins Hadley School Blind
Secretary	John Jackobs Coe College	John Jackobs Coe College	John Jackobs Coe College	Dudley Bryant Western Kentucky
Board Members	Keith Pothoven Central College	Keith Pothoven Central College	Robert Hodge Taylor University	Robert Hodge Taylor University
At Large	Bob Renners Kenyon College	Carol Paris Goshen College	Carol Paris Goshen College	Ann Roskow Ister CC
Public Relations	Dough Hughes Dennison University	Wally Roth Taylor University	Wally Roth Taylor University	Wally Roth Taylor University
Librarian	Jack Cundiff Muskingum College	Jack Cundiff Muskingum College	Jack Cundiff Horry-Georgetown	Jack Cundiff Horry-Georgetown
Equip. Coordinator				
Web Coordinator				
Location:	W. Kentucky	Vincennet	Myrtle Beach	Myrtle Beach

ASCUE BOARD OF DIRCTORS FROM 1988 to 1992

	1988-89	1989-90	1990-91	1991-92
President				
	David Cossey	Tom Warger	David Redlawsk	Bill Wilson
	Union College	Bryn Mawr College	Rudgers University	Gettysburg College
Program Chair				
	Tom Warger	David Redlawsk	Bill Wilson	Carl Singer
	Bryn Mawr College	Rudgers University	Gettysburg College	DePauw University
Past President				
	Keith Pothoven	David Cossey	Tom Warger	David Redlawsk
	Central College	Union College	Bryn Mawr College	Rudgers University
Treasurer				
	Maureen Eddins	Maureen Eddins	Tom Pollack	Tom Pollack
	Hadley School Blind	Hadley School Blind	Duquesne University	Duquesne University
Secretary				
	Dudley Bryant	Kathy Decker	Kathy Decker	Dagrun Bennett
	Western Kentucky	Clarke College	Clarke College	Franklin College
Board Members				
	Kathy Decker	Dagrun Bennett	Dagrun Bennett	Mary Connolly
	Clarke College	Franklin College	Franklin College	Saint Mary's College
At Large				
	Ann Roskow	Rick Huston	Rick Huston	Rick Huston
	Ister CC	South Caolina/Aiken	South Caolina/Aiken	South Caolina/Aiken
Public Relations				
	Wally Roth	Wally Roth	Wally Roth	Wally Roth
	Taylor University	Taylor University	Taylor University	Taylor University
Librarian				
	Jack Cundiff	Jack Cundiff	Jack Cundiff	Jack Cundiff
	Horry-Georgetown	Horry-Georgetown	Horry-Georgetown	Horry-Georgetown
Equip. Coordinator				
Web Coordinator				
Sponsor Relations Coordinator				
Location:	Myrtle Beach	Myrtle Beach	Myrtle Beach	Myrtle Beach

ASCUE BOARD OF DIRCTORS FROM 1992 to 1996

	1992-93	1993-94	1994-95	1995-96
President	Carl Singer	Rick Huston	Mary Connolly	Paul Tabor
	DePauw University	South Carolina/Aiken	Saint Mary's College	Clarke College
Program Chair	Rick Huston	Mary Connolly	Paul Tabor	Carl Singer
	South Carolina/Aiken	Saint Mary's College	Clarke College	DePauw University
Past President	Bill Wilson	Carl Singer	Rick Huston	Mary Connolly
	Gettysburg College	DePauw University	South Carolina/Aiken	Saint Mary's College
Treasurer	Tom Pollack	Tom Pollack	Tom Pollack	Tom Pollack
	Duquesne University	Duquesne University	Duquesne University	Duquesne University
Secretary	Dagrun Bennett	Dagrun Bennett	Dagrun Bennett	Dagrun Bennett
	Franklin College	Franklin College	Franklin College	Franklin College
Board Members	Mary Connolly	Gerald Ball	Gerald Ball	Rick Huston
	Saint Mary's College	Mars Hill College	Mars Hill College	South Carolina/Aiken
At Large	Tom Gusler	Tom Gusler	Tom Gusler	Tom Gusler
	Clarion University	Clarion University	Clarion University	Clarion University
Public Relations	Don Armel	Don Armel	Don Armel	Peter Smith
	Eastern Illinois U.	Eastern Illinois U.	Eastern Illinois U.	Saint Mary's College
Librarian	Jack Cundiff	Jack Cundiff	Jack Cundiff	Jack Cundiff
	Horry-Georgetown	Horry-Georgetown	Horry-Georgetown	Horry-Georgetown
Equip. Coordinator				
Web Coordinator				
Sponsor Relations Coordinator				
Location:	Myrtle Beach	Myrtle Beach	Myrtle Beach	Myrtle Beach

ASCUE BOARD OF DIRCTORS FROM 1996 to 2000

	1996-97	1997-98	1998-99	1999-2000
President	Carl Singer DePauw University	Carl Singer(acting) DePauw University	Bill Wilson Gettysburg College	Dagrun Bennett Franklin College
Program Chair	Chris Schwartz Ursuline College	Bill Wilson Gettysburg College	Dagrun Bennett Franklin College	Carol Smith DePauw University
Past President	Mary Connolly Saint Mary's College	Mary Connolly Saint Mary's College	Carl Singer DePauw University	Bill Wilson Gettysburg College
Treasurer	Tom Pollack Duquesne University	Tom Pollack Duquesne University	Tom Pollack Duquesne University	Tom Pollack Duquesne University
Secretary	Dagrun Bennett Franklin College	Dagrun Bennett Franklin college	Tom Gusler Clarion University	Nancy Thibeault Sinclair CC
Board Members	Richard Stewart Lutheran Theological	Richard Stewart Lutheran Theological	Nancy Thibeault Sinclair CC	Fred Jenny Grove City College
At Large	Rick Huston South Carolina/Aiken	Rick Rodger Horry-Georgetown	Rick Rodger Horry-Georgetown	George Pyo Saint Francis College
Public Relations	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College
Librarian	Jack Cundiff Horry-Georgetown	Jack Cundiff Horry-Georgetown	Jack Cundiff Horry-Georgetown	Jack Cundiff Horry-Georgetown
Equip. Coordinator				Rick Huston South Carolina/Aiken
Web Coordinator				
Sponsor Relations Coordinator				
Location:	Myrtle Beach	Myrtle Beach	Myrtle Beach	Myrtle Beach

ASCUE BOARD OF DIRCTORS FROM 2000 to 2004

	2000-01	2001-02	2002-03	2003-04
President	Carol Smith DePauw University	Fred Jenny Grove City College	Nancy Thibeault Sinclair CC	Barry Smith Baptist Bible College
Program Chair	Fred Jenny Grove City College	Nancy Thibeault Sinclair CC	Barry Smith Baptist Bible College	George Pyo Saint Francis College
Past President	Dagrun Bennett Franklin College	Carol Smith DePauw University	Fred Jenny Grove City College	Nancy Thibeault Sinclair CC
Treasurer	Tom Pollack Duquesne University	Tom Pollack Duquesne University	Tom Pollack Duquesne University	Tom Pollack Duquesne University
Secretary	Nancy Thibeault Sinclair CC	Kim Breighner Gettysburg College	Kim Breighner Gettysburg College	Kim Breighner Gettysburg College
Board Members	Barry Smith Baptist Bible College	Barry Smith Baptist Bible College	David Frace CC Baltimore County	David Frace CC Baltimore County
At Large	George Pyo Saint Francis College	George Pyo Saint Francis College	George Pyo Saint Francis College	Jim Workman Pikeville College
Public Relations	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College
Librarian	Jack Cundiff Horry-Georgetown	Jack Cundiff Horry-Georgetown	Jack Cundiff Horry-Georgetown	Jack Cundiff Horry-Georgetown
Equip. Coordinator	Rick Huston South Carolina/Aiken	Hollis Townsend Young Harris College	Hollis Townsend Young Harris College	Hollis Townsend Young Harris College
Web Coordinator			Carol Smith DePauw University	Carol Smith DePauw University
Sponsor Relations Coordinator				
Location:	Myrtle Beach	Myrtle Beach	Myrtle Beach	Myrtle Beach

ASCUE BOARD OF DIRCTORS FROM 2004 to 2008

	2004-05	2005-06	2006-07	2007-08
President				
	George Pyo	Jim Workman	Lisa Fears	George Pyo
	Saint Francis College	Pikeville College	Franklin College	Saint Francis College
Program Chair				
	Jim Workman	Lisa Fears	George Pyo	Fred Jenny
	Pikeville College	Franklin College	Saint Francis College	Grove City College
Past President				
	Barry Smith	George Pyo	Jim Workman	Lisa Fears
	Baptist Bible College	Saint Francis College	Pikeville College	Franklin College
Treasurer				
	Tom Pollack	Tom Pollack	Tom Pollack	Tom Pollack
	Duquesne University	Duquesne University	Duquesne University	Duquesne University
Secretary				
	Kim Breighner	Kim Breighner	Kim Breighner	Kim Breighner
	Gettysburg College	Gettysburg College	Gettysburg College	Gettysburg College
Board Members				
	Lisa Fears	Blair Benjamin	Blair Benjamin	Janet Hurn
	Franklin College	Philadelphia Bible	Philadelphia Bible	Miami U. Middleton
At Large				
	David Frace	David Frace	David Fusco	David Fusco
	CC Baltimore County	CC Baltimore County	Juniata College	Juniata College
Public Relations				
	Peter Smith	Peter Smith	Peter Smith	Peter Smith
	Saint Mary's College	Saint Mary's College	Saint Mary's College	Saint Mary's College
Librarian				
	Jack Cundiff	Jack Cundiff	Jack Cundiff	Jack Cundiff
	Horry-Georgetown	Horry-Georgetown	Horry-Georgetown	Horry-Georgetown
Equip. Coordinator				
	Hollis Townsend	Hollis Townsend	Hollis Townsend	Hollis Townsend
	Young Harris	Young Harris	Young Harris	Young Harris
Web Coordinator				
	Carol Smith	David Diedreich	David Diedriech	Blair Benjamin
	DePauw University	DePauw University	DePauw University	Philadelphia Bible
Sponsor Relations Coordinator				
Location:	Myrtle Beach	Myrtle Beach	Myrtle Beach	Myrtle Beach

ASCUE BOARD OF DIRCTORS FROM 2008 to 2012

	2008-09	2009-10	2010-2011	2011-2012
President				
	Fred Jenny Grove City College	Janet Hurn Miami U Middleton	Janet Hurn Miami U Middleton	Andrea Han U of British Columbia
Program Chair				
	Janet Hurn Miami U Middleton	Dave Fusco Juniata College	Andrea Han U of British Columbia	Tom Marcais Sweet Briar College
Past President				
	George Pyo Saint Francis College	Fred Jenny Grove City College	Fred Jenny Grove City College	Janet Hurn Miami U Middleton
Treasurer				
	Tom Pollack Duquesne University	Tom Pollack Duquesne University	Dave Fusco Juniata College	Dave Fusco Juniata College
Secretary				
	Kim Breighner Gettysburg College	Kim Breighner Gettysburg College	Kim Breighner Gettysburg College	Kim Breighner Gettysburg College
Board Members				
	Dave Fusco Juniata College	Thomas Marcais Lee University	Thomas Marcais Lee University	Jeffery LeBlanc U of NW Ohio
At Large				
	Andrea Han Miami U Middleton	Andrea Han Miami U Middleton	Mark Poore Roanoke College	Mark Poore Roanoke College
Public Relations				
	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College	Peter Smith Saint Mary's College
Librarian				
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Location:	Myrtle Beach	Myrtle Beach	Myrtle Beach	

The Results of Using Open Educational Resources and Virtual Reality in Higher Education

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Abstract

Educational technology has exploded at a rapid pace, requiring educational institutions to select the most innovative techniques and platforms to complement instruction. Incorporating the latest technologies such as Open Educational Resources (OER) and Virtual Reality (VR) into curricula have proven to be beneficial in the areas of active engagement and student-centered learning. For instructors of higher education, it is not a matter of "if" the use of technology will increase in the classroom but "how." This paper discusses OER and VR and how these technology resources can be implemented into lesson design through a study conducted at two universities in North Carolina.

Introduction

Research reveals that reality platforms have already impacted the world significantly, and OER and VR being present among modern technology tools for instruction. It is imperative to note that today's learners learn best with the integration of digital technologies, and the use of OER and VR enables instructors to accommodate current learning styles (Smale and Regalado, 2018, p. 1). Additionally, "technology use in the classroom is rapidly changing how we teach, how children learn, and how school districts spend their resources" (Armstrong, 2014). The primary focus of this paper is to reveal the results from two years of study on the subjects of OER and VR at each university. Graphics are included to display survey outcomes better.

Ease and Affordability

In terms of students, affordability is one of the most significant challenges higher education institutions face today. To overcome this battle, universities are looking to adopt resources that are more affordable for college students (Colvard, Watson, & Park), thus, explaining why Open Educational Resources (OER) and Virtual Reality (VR) are receiving massive attention, as these are avenues that lower student textbook cost and provide current materials through platforms which allow the instructor to access, adapt, and distribute resources to support their course curricula (Taylor & Taylor, 2018).

OER was incorporated into READ 400 Practicum in Correction of Reading Problems course at one of the universities in the study. This course is taken by pre-service teachers earning their bachelor's degree in elementary education with a concentration in reading. Intellus, an OER popular platform, was chosen by the instructor to explore OER, which was easy to navigate and implement in the course. The OER selected from Intellus worked smoothly with Canvas (Learning Management System), as the instructor could embed the resources into course modules with ease. Also, Intellus enables instructors to produce a syllabus through their platform, which allows students to click on links that directly navigate them to the OER for that particular module. Intellus makes it easy for faculty to find, adapt, and modify high-quality resources for courses (Amman, 2018). See below for a list of selected resources used in READ 400.

Module 1 - Beliefs about Reading

- "A Diagnostic Teaching Intervention for Classroom Teachers: Helping Struggling Readers in Early Elementary School." Library (EBSCO). Academic Search Complete [a9h], 31 Oct. 2010. Article/Journal.
- "Teaching struggling readers in elementary school classrooms: A review of classroom reading programs and principles for instruction." Library (EBSCO). Academic Search Complete [a9h], 31 Jan. 1999. Article/Journal.
- "PLCs in Action: Innovative Teaching for Struggling Grade 3-5 Readers." Library (EBSCO).
- Academic Search Complete [a9h], 30 Sep. 2013. Article/Journal.
- "Get to Know Your Students" Youtube. 05 Jan. 2017. Video.

Module 2 - Reading Motivation & Early Literacy: Sessions with Client

- Dr. Andy Johnson. "Motivating Students to Read: 11 TIPS" Youtube. 28 Feb. 2014. Video.
- "Supporting English-Language Learners and Struggling Readers in Content Literacy With the "Partner Reading and Content, Too" Routine." Library (EBSCO). Academic Search Complete [a9h], 31 Mar. 2010. Article/Journal.
- "REACHING STRUGGLING READERS." Library (EBSCO). Academic Search Complete [a9h], 30 Apr. 2015. Article.

Module 3 - Reading Levels: Sessions with Client

- "Revisiting Key Assumptions of the Reading Level Framework." Library (EBSCO). Academic Search Complete [a9h], 31 Aug. 2012. Article/Journal.

Module 4 - Phonics Instruction: Sessions with Client

- Lucia Parry. "Whole Group Phonics Lesson - Parry" Youtube. 14 Feb. 2013. Video.
- Lucia Parry. "Phonics Small Group - Parry" Youtube. 14 Feb. 2013. Video.
- Mindset Teach. "Phonics" Youtube. 10 Dec. 2013. Video.

Module 5 - Vocabulary: Sessions with Client

- "Four Corners Strategy" Youtube. 23 Feb. 2017. Video.
- AmericanGraduateDC. "Explicit Vocabulary Teaching Strategies" Youtube. 30 Apr. 2012. Video.

Module 6 - Reading Comprehension: Sessions with Client

- "High 5!" Strategies to Enhance Comprehension of Expository Text." Library (EBSCO). Academic Search Complete [a9h], 31 Oct. 2010. Article/Journal.
- "Help with teaching reading comprehension: Comprehension instructional frameworks." Library (EBSCO). Academic Search Complete [a9h], 30 Apr. 2006. Article/Journal.
- Shannon Oden. "Teaching Reading Fluency and Comprehension" Youtube. 05 Jul. 2011. Video.
- "The Interactions of Vocabulary, Phonemic Awareness, Decoding, and Reading Comprehension." Library (EBSCO). Academic Search Complete [a9h], 31 Jan. 2013. Article/Journal.
- "Fluency: Bridge between decoding and reading comprehension." Library (EBSCO). Academic Search Complete [a9h], 28 Feb. 2005. Article/Journal.

Intellus helps instructors access high-quality resources quickly through the "explore" database. The search capability allows faculty to narrow the search to precisely the type of resource they wish to embed in their curricula. For example, instructors have the choice to choose date of publication, source (EBSCO, Pearson, Youtube, TED talk, videolectures.net, wisc-online, article, etc.) and type (article/journal, assignment, case study, assessment, audio, data, eBook, flash cards, exam, games, interactive tutorial, lecture notes, lesson plans, podcast, video, webpage, etc.). Making the transition to incorporate OER in a course is a bit challenging. When embedding OER. faculty have to know how to evaluate information for quality and relevance, as there are so many open resources available (Pierce, 2016). Therefore, this takes a lot of preparation when redesigning a course. However, after seeing how Intellus impacted student engagement and learning in READ 400, the extra planning was undoubtedly worth the time.

OER Ease of Use for Students

During this project implementation, students were able to navigate through the OER effortlessly. One barrier that students encountered is that they must have Internet connectivity to explore the OER fully (Olufunke & Adegun, 2014). Since most universities have a library and free WiFi for students, the benefits of OER outweigh this challenge. Additionally, most universities are near restaurants that offer free WiFi services to students.

In a survey distributed to students in READ 400, 100% of the participants rated Intellus to be easy or moderately easy to use. See Figure 1

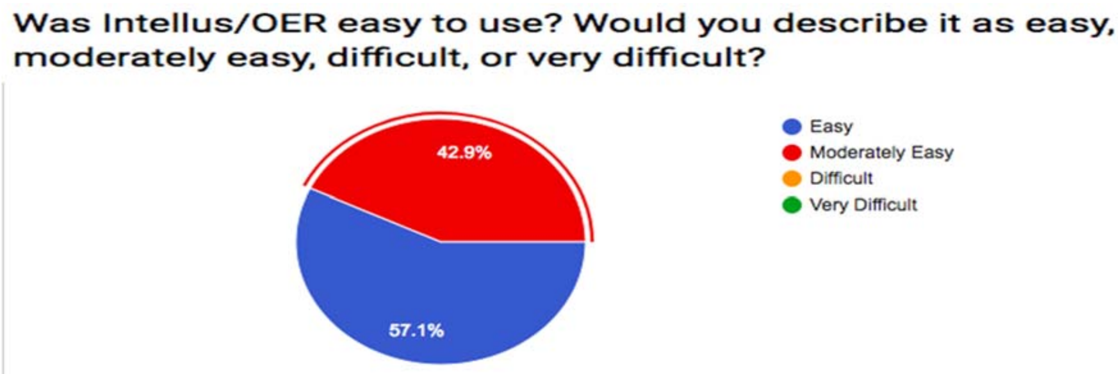

Figure 1. Screenshot of Survey Data

OER Impact on Student Learning and Engagement

Intellus had a positive impact on student learning and engagement in READ 400. OER provided multiple avenues for students to express themselves, as they could interact, communicate, and respond to class assignments. Findings have revealed that the use of OER increases student motivation as resources are relevant and of interest to the learner (Sulisworo, Sulistyo, & Akhsan, 2017).

In a survey distributed to READ 400 students, 100% of participants felt that Intellus made a positive difference in their learning and engagement (see Figure 2). Additionally, students were asked to provide examples of ways the resources enhanced or did not enhance knowledge. One student stated, "I was able to engage with other students as well as Dr. Holder very easily." Another student mentioned, "I especially liked the videos, I am a visual/demonstration learner, so the videos were a great help." Moreover, students commented on the resources in Intellus stating, "Intellus provided excellent materials for the course."

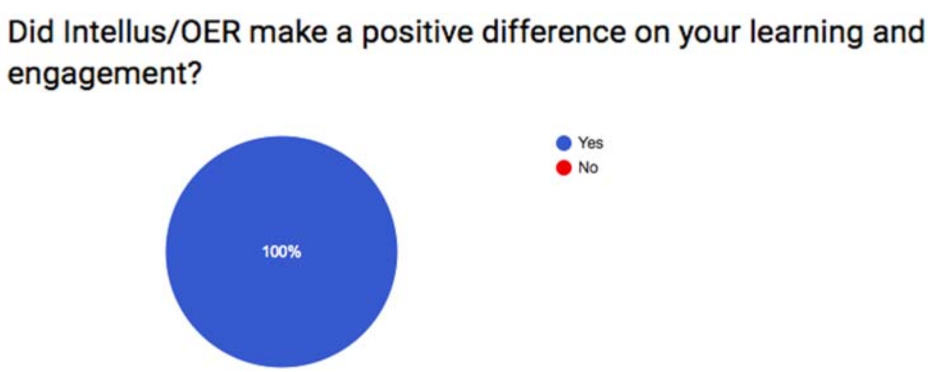

Figure 2. Screenshot of Survey Data

It is also important to note that based on survey results for READ 400, 100% of participants revealed that they would like to use Intellus in future college courses. See Figure 3

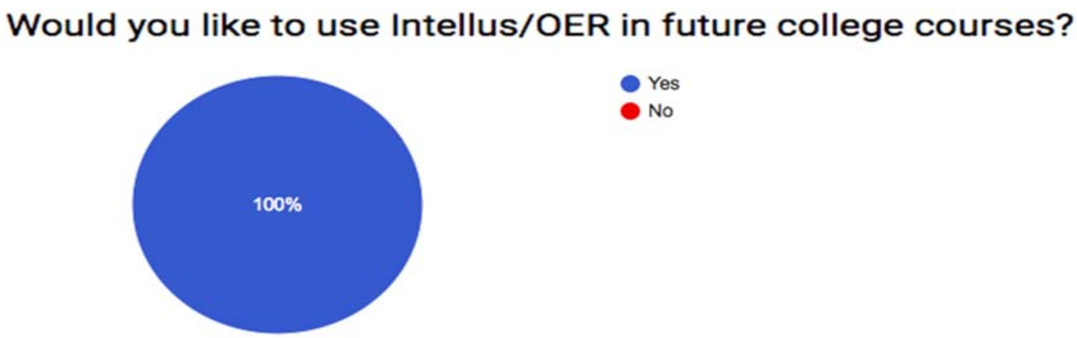

Figure 3. Screenshot of Survey Data

How does OER Compare to the Traditional Textbook?

Just like the traditional textbook, OER has the potential to enhance student achievement. In a study conducted by Ikahihifo, Spring, Rosecrans, and Watson (2017), college students rated OER to be just as or even more engaging than traditional texts.

It is estimated that the average student spends over $1000 per year on textbooks alone. OER reduces school costs for students, which removes the barrier between the student and their career pathway. Educators have found that university students appreciate the value in OER, as some students do not have additional funds beyond their scholarships and work-study awards (Lashley, Cummings-Sauls, Bennett, & Lindshield, 2017).

In a study conducted by Vojtech, Gabrielle, Grissett, and Judy (2017), college students expressed that they would instead use OER in place of the traditional text due to the creativity of the course. In the same study, students reiterated that the cost was indeed a benefit as they were not expected to purchase a text when using OER. It is important to note that in a study conducted at eight colleges across the United States, researchers found that both teachers and students rated OER to be at least equal in quality to traditional texts (Bliss, Robinson, Hilton, Wiley, 2013).

Based on survey results distributed to READ 400 students during data collection, 71% expressed that they would prefer using Intellus over the traditional text. See Figure 4

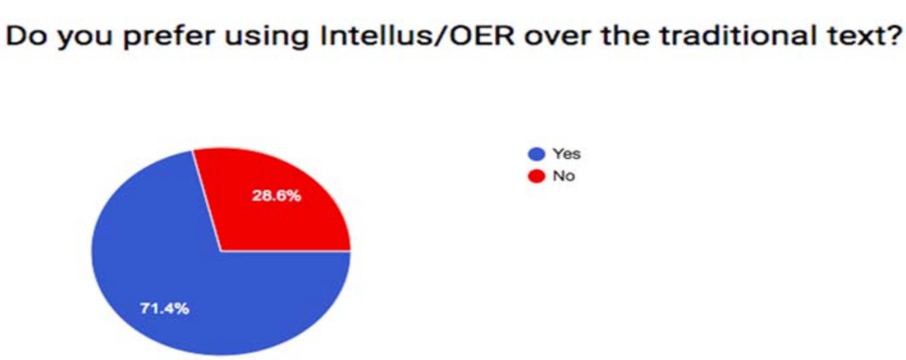

Figure 4. Screenshot of Survey Data

Students were also asked to compare the quality of OER provided through Intellus and those offered through their regular textbook. One student quoted, “I am more traditional; however, both worked effectively.” Another shared, “I like a textbook in my hands; however, I did like articles and videos provided through OER.” “Personally, I would like both items when taking a course.” Another student commented, “Both sources offer the same information, I carry my phone everywhere, but textbooks sometimes get forgotten.” Lastly, “My professor made learning easy with the OER, and I learned more with the combination of the learning material and my professor than just using the textbook.”

VR in the Classroom

Each year students enrolled in EDUC 455 Foundations of Technology for Educators course experience the use of VR in the classroom. Students taking the course are K-12 teacher candidates seeking teacher licensure. The course is taught face-to-face and online. Students in the face-to-face class work with the 52 cardboard VR sets available in the classroom and students in the online version of the class conduct research, read articles, and watch videos on the use of VR in the classroom. Online students are also encouraged to purchase a low-cost VR cardboard set. Students are intrigued and highly motivated to participate in activities associated with VR or to conduct research on the subject. Through the sharing of VR research and experiences with fellow higher education instructors, all have provided similar feedback stating that VR is a fun and exciting way to introduce new concepts, content, and materials.

The Role of Virtual Reality in Education

Completing courses requiring the use of technology as a resource is a norm for students enrolled in learning institutions globally. Many assume that VR is only used for entertainment purposes, such as gaming, movies, and even reading novels. However, VR is much more than entertainment and serves as a resource for medicine, science, training, and education. VR relates to education and the potential benefits available to students. Barbara L. Ludlow, chair of the department of special education at West Virginia University shares that virtual environments should be included in schools and higher education institutions. “VR is an emerging technology that has resulted in a rapid expansion in the development of immersive virtual environments for use as educational simulations in schools, colleges, and universities (Ludlow, 2015).” VR is a technology that projects images of the environment to appear real. New studies indicate that applying VR devices in the classroom has likely outcomes resulting in more effective learning environments. VR allows students to learn in settings that look and feel real.
VR technology can assist traditional students as well as students with learning disabilities by giving them an alternate learning style helping them learn more effectively through social reasoning and judgment. VR devices are an alternative to traditional teaching by providing new experiences, including virtual field trips, lectures, unique activities, and laboratory experiments. The primary question posed to educators is if this technology should be embedded in the curriculum and how VR devices can be used to transform the education system.

VR Impact on Student Learning and Engagement

Since EDUC 455 is a class designed for candidates planning on becoming elementary, middle, secondary, or K-12 public school teachers, during the course students participated in a practicum. The course familiarizes candidates with strategies that focus on the integration of technology into their work as teachers. Activities concentrate on candidate integration of technology in communications and infusion of technology in the learning process, differentiation, assessment strategies, and the potential inclusion of emerging technology in the classroom. Candidates enrolled in the class demonstrate an understanding of the capabilities and limitations of technology with an emphasis on student engagement and its use in education as well as its impact on society. The focus of the PowerPoint and VR activity was to measure teacher candidate engagement and to promote differentiation. Students participated in activities that were directly related to comparing the use of PowerPoint and VR. Students were also able to use Google search as an alternative in the lesson as well.

The following results are from data collected 2016-2018. Students participated in in-class activities that compared the use of PowerPoint presentations with the same content presented through VR. For this survey, students were given an in-class assignment to research many places on the Internet. In advance, a Webquest was created by the instructor that contained research on PowerPoints that highlighted the locations in the activity. Students could access the PPT Webquest via Google Classroom. The study included cities, countries, and places that rural students may or may not have the opportunity to visit in person. Students were required to locate major monuments, parks, and popular sites. Included in the list were Tokyo, China, Paris, and New York City. The students received a handout with the following instructions: 1) Use the PPT Webquest to visit the following locations. 2) After visiting the sites from the PPT Webquest - Search independently for the same places if you feel you need additional information to answer the questions 3) Write a paragraph on your findings and include at least 3 facts and finally 4) Share your experience with the person to the right of you.

Sample questions included in the activity are as follows: What does the Skytree tell you about the culture of the city of Tokyo? What is important in US history about Tiananmen Square, Beijing, and What are some interesting facts about the Eiffel Tower, Paris? This assignment was given to EDUC 455 classes over four semesters. Upon completing this in-class activity, students were then asked to complete a Likert Scale survey ranging from “Very Engaged to Not Engaged.” In Figure 5, students rated their level of engagement using PowerPoint: <6% Very Engaged, 22.7% Engaged, 36.4% Moderately Engage, and 36.4% Not Very Engaged. In Figure 6, students rated their level of engagement using VR: 77.3% Very Engaged, 18.2% Engaged, and 5% Moderately Engaged. In Figure 7 students were asked if they would rather include PPT or VR in the same type lesson or if they would instead use Google on their own without the Webquest: 95.5% of students choose VR. Finally, in Figure 8 students shared in a discussion about the differences in activities using PPT and VR: 1) VR is more engaging 2) Looking up the PPT was tedious and boring 3) VR was much more exciting because I could see the places. The PowerPoints gave me more information than experience 4) VR was more fun and involved, and 5) The VR allowed us to see more about the cities and places we visited instead of just a picture of the actual thing. According to the results of this study, students overwhelmingly preferred VR over PPT activities. Additionally, teacher candidates enrolled in practicum and student teaching viewed VR as more engaging.

Figure 5. Students rate their level of engagement using PowerPoint.

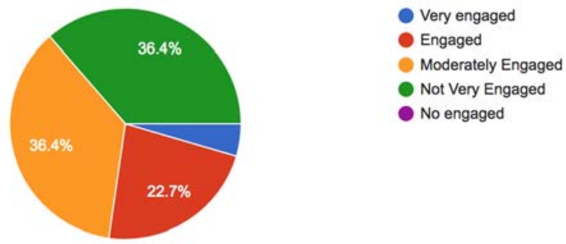

Figure 6. Students were asked how they rated the level of engagement using VR.

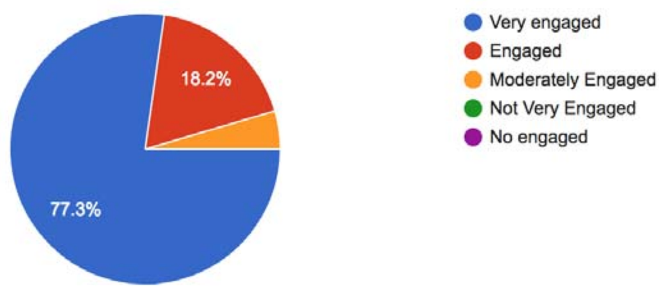

Figure 7. Students were asked which activity they would instead include in their lesson plans - PPT or VR?

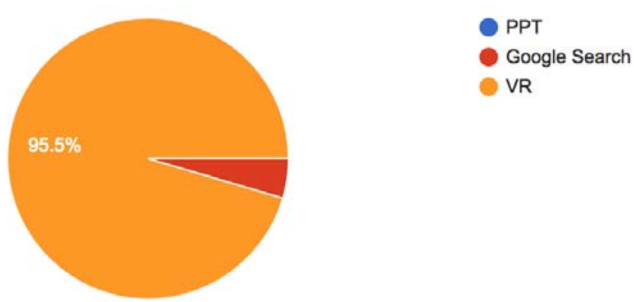

Figure 8. The table below reveals student comments about the differences in the two activities (PPT and VR).

VR is more engaging
Looking up the power point was tedious and boring and the information I found seemed blah compared to the virtual reality.
The VR was much more engaging because I could actually see the places. The power points gave me more information than experience.
The power points were so different based off of what you clicked so it would be kind of confusing. VR headsets with the app made the activities engaging
Virtual Reality was more engaging ecause it really felt like we were experiencing it ourselves. The researching of the powerpoint was cool, but there were not many that I felt was especially aesthetically pleasing nor informative.
VR was more fun and involved
the VR world
The VR really allowed you to see more about the cities and places we visited. Instead of just a picture of the actual thing, we got to see it and what is around the particular place. On the power point we were only able to see a simple picture.
The Virtual Reality (VR) activities was more interesting and exciting than looking at the power point presentations.

Future Possibilities with OER and VR

The Internet has vastly increased the amount of information accessible to classrooms. In the same way, OER and VR increase learning opportunities by offering flexible lesson planning and additional opportunities for students to choose their mode of learning. These digital resources transform education and bring the outside world into the classroom. OER and VR are increasingly becoming the digital tools of choice for lessons that promote the student-centered concept. When exploring these technologies, learners can control what they research, which results in personalized learning experiences that are self-centered (Afolabi, 2017). Due to the flexibility and openness of these digital tools, there is more room for instructors to integrate best teaching practices into their instruction, which increases student knowledge and skills (McGreal, 2017). Additionally, using OER and VR enable instructors to provide more differentiated and customized instruction in the classroom, which opens the opportunity to meet the needs of diverse learners (Kwak, 2017). This technology is an essential factor in assisting universities in delivering high-quality education.

Summary

At the onset of working with OER and VR in the higher education classroom, one becomes skeptical about how students will truly gain academic value. However, after incorporating these technologies into classroom instruction, the researchers found that higher education instructors would be doing students a disservice by not integrating this technology into daily lessons. Additionally, it was revealed that there are strengths to the use of OER and VR. Aside from the educational benefits of being able to take students outside of the classroom without actually traveling; VR is an avenue for exploring the jungles of Africa, museums in Italy, or war zones around the world. One of the significant benefits is being able to move safely around dangerous places while remaining far away from the real dangers" (Freina & Ott, 2015). A challenge for students is to understand how to explore regarding academics. Therefore, the use of VR and the ability to navigate while learning can be a new experience for students. Students gain skills through the use of VR, even when the experiences are for recreational purposes. Additionally, OER provides current material relevant to today's learners, which assist instructors in maximizing engagement throughout lesson delivery.

For the most part, today's students are tech-savvy and grasp the concept of newly implemented applications with ease. It is not to say that notebook paper, pencils, or chalkboards are no longer needed, but there is a need to stimulate students in areas that challenge them in several areas. By using OER and VR, educators and students can thrive, and the educational experience becomes not only more enjoyable but can leave longer-lasting impressions on the students.

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Experience Teaching Emerging Information Technologies

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Abstract

This paper discusses our experiences teaching a doctoral-level course in emerging information technologies. The concept of emerging technologies is put into context by describing the technology life cycle. The emerging information technologies of current interest – Artificial Intelligence and related areas, Collective Human-Computer Intelligence, Blockchain, Quantum Computing, Cybersecurity, Biometrics, and Internet Platform Businesses – are described and the distinctions among them explained. We conclude that teaching emerging information technologies is an area rich with opportunity for growth.

Introduction

The rapid digitization of our world, with the subsequent blurring of the boundary between the physical, digital, and biological, together with continual improvements in the cost/performance of computing, storage, and networking, are driving the emergence of novel, rapidly evolving technologies that have a strong potential for impact in the future. These technologies are often disruptive; they can change the way businesses and whole industries operate, have socio-economic impacts (e.g., eliminate jobs and create new ones), and raise new ethical, legal, policy, and regulation challenges. For all these reasons, it is important for students to have a basic understanding of current emerging technologies and the impact they can have (and are having) on government and citizens, industry and employees, and academia -- including students, faculty and staff.

Our focus is on emerging and disruptive information technologies (not, for example, genetic engineering or additive manufacturing). We cover selected technologies based on faculty background and interests and potential industry collaboration. Currently, these include (1) Artificial Intelligence, Machine Learning, Deep Learning, and Neural Networks and their application, (2) Collective Human-Computer Intelligence (Malone 2018), (3) Quantum Computing (for exponential scaling in performance on important applications), (4) Cybersecurity and Biometrics, (5) Internet platform businesses, and (6) Blockchain (a distributed ledger) and its application.

Pace University has individual graduate courses in many of these areas. The course under discussion here introduces the technologies, identifies open research problems, discusses potential long-term impact and current applications, raises awareness of ethical issues raised, and addresses new business models, e.g., "Internet Platforms" (McAfee & Brynjolfsson, 2017). Students graduating from the course have a strong understanding of emerging technologies and their application, understand the potential for applying them in their own work (business or research), and may get ideas for their doctoral dissertations. In the future, we hope to include topics in imbedded intelligence (e.g. robotics, autonomous vehicles) and cyber-physical security.

Given the pervasiveness of many of these technologies and the rapid rate of change, a course on Emerging Technologies would serve the needs of students enrolled in undergraduate and graduate degree programs in Computer Sciences and Information Systems. We believe the Emerging Information Technologies course (in Pace University's Doctor of Professional Studies (DPS) in computing) can be effectively re-structured to serve this need.

The following sections describe the technology life cycle, the doctoral course we are currently teaching, the various emerging information technologies of current interest, and some conclusions.

The Technology Life Cycle

To put the concept of an emerging technology into context, it is important to describe the "S" shaped curve representation of the technology life cycle (Fig. 1). This curve shows the four main phases of the technology life cycle: the invention of the technology, the emergence as the technology is being developed, the maturity when the technology becomes established and accepted, and finally saturation when the technology becomes wide-spread and fully appreciated, as shown by the flattening of the growth curve.

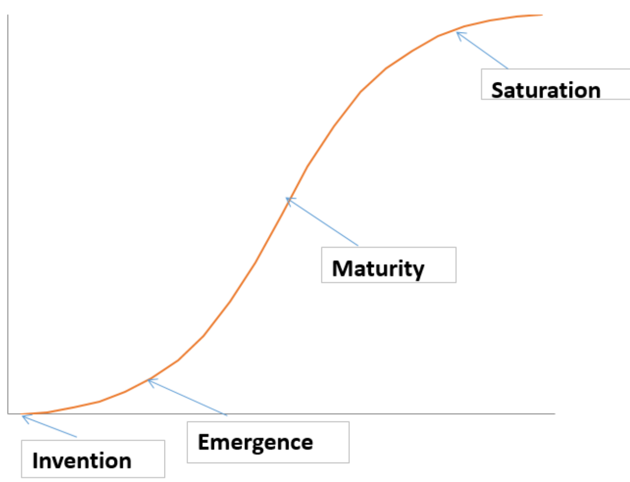

Fig. 1. The "S" shaped curve of the technology life cycle (drawn by authors).

These phases of the technology life cycle, together with some additional phases, have been described by several authors, including Kendall (1999) and Kurzweil (1999) whose life cycle phases are shown in Fig. 2. Let's follow some technologies through the life cycle. The airplane was invented in 1903 by the Wright brothers when they achieved the first powered and controlled machine flight. Shortly after the invention, longer powered flights were performed by planes with improved designs as the technology emerged and developed. Airplanes were further developed and used during WWI and WWII, and with the wide-spread availability of air travel today the technology is currently fully matured and established, but may not have reached saturation because there remain many regions of the world having little access to airplanes. Another phase of Kurzweil's life cycle is the dream or contemplation and, in this case, long before the invention, Leonardo da Vinci in the 15th century contemplated flying machines through his sketches and designs.

Turning to the technology of writing instruments, not too long ago we used pen and ink, first using pens that were dipped into ink and then using fountainpens that allowed the user to write for some time before having to refill the ink bladder of the pen. These technologies are now obsolete and relegated to antiquity, except perhaps for their use by calligraphers, because they have essentially been replaced by the ballpoint pen.

Kendall

1. Invention
2. **Emergence**
3. Acceptance (established)
4. Sublime (fully appreciated)
5. Surplus

Kurzweil

0. Precursor (dream/contemplation)
1. Invention
2. **Development (emergence)**
3. Maturity (established)
4. Pretenders (threat by upstart)
5. Obsolescence (by new tech)
6. Antiquity

Fig. 2. The Kendall and Kurzweil phases of the technology life cycle (drawn by authors).

Although the exponential growth curve of a technology flattens out, new technologies invariable emerge to keep growth exponential. An example of this is the growth of computer technology – from mechanical switches in the 1890s to relay-based switches in the 1940s to vacuum tubes in the 1950s to transistors in the 1960s and to integrated circuits in the 1970s. Just-in-time arrival of new technologies pick up from the flattening technology curve to maintain exponential growth (linear growth on a log scale). Each technology has an S-shaped growth curve and the concatenation of these S-shaped curves produces an exponential curve Fig. 3 (left). Furthermore, when the arrival of new technologies is accelerated through synergies, the result is accelerated returns (change) faster than exponential growth, curving toward double exponential growth (Kurzweil, 1999), shown as an exponential on a log scale in Fig. 3 (right). An example of the accelerated growth of a technology through the synergistic effects of enabling technologies is the human genome project (1990-2003) that was estimated to take 1000 years of research but was completed in 13 years (Human Genome Project, 2019). Perhaps it should not surprise us that a 1000 year project took only 13 years at a double exponential rate since $2^{10} \sim 1000$.

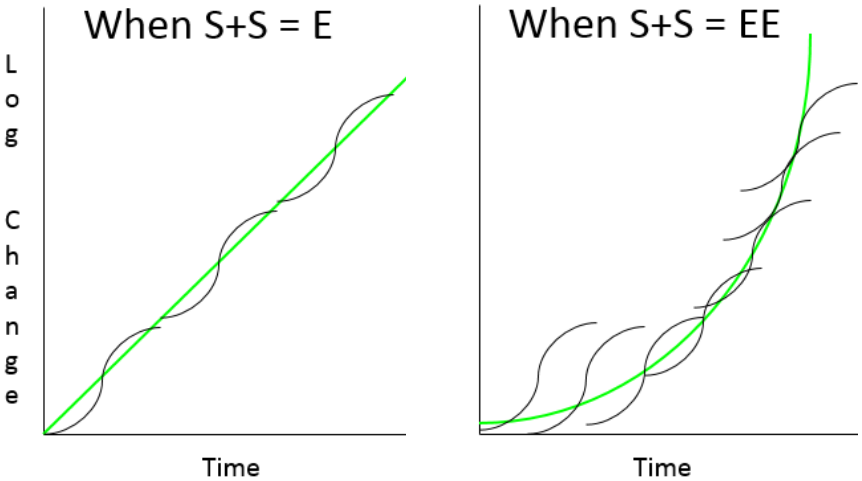

Fig. 3. Log scale just-in-time new technology arrival yields exponential growth (left), while synergy-accelerated arrival yields double exponential growth (right) (drawn by authors).

More recently, the maturity phase of the life cycle S-shaped curve has become steeper (Fig. 4). People are adopting technologies at an unprecedented pace, and good examples are social media and smart phones. It is difficult to predict the impact of technologies like computer vision and speech recognition that are at the cusp of a steep maturity curve. In business, predicting the adoption rate accurately can be the difference between success and failure. In an emerging technologies course, instructors should be careful about claims and students made aware of this unpredictability through examples.

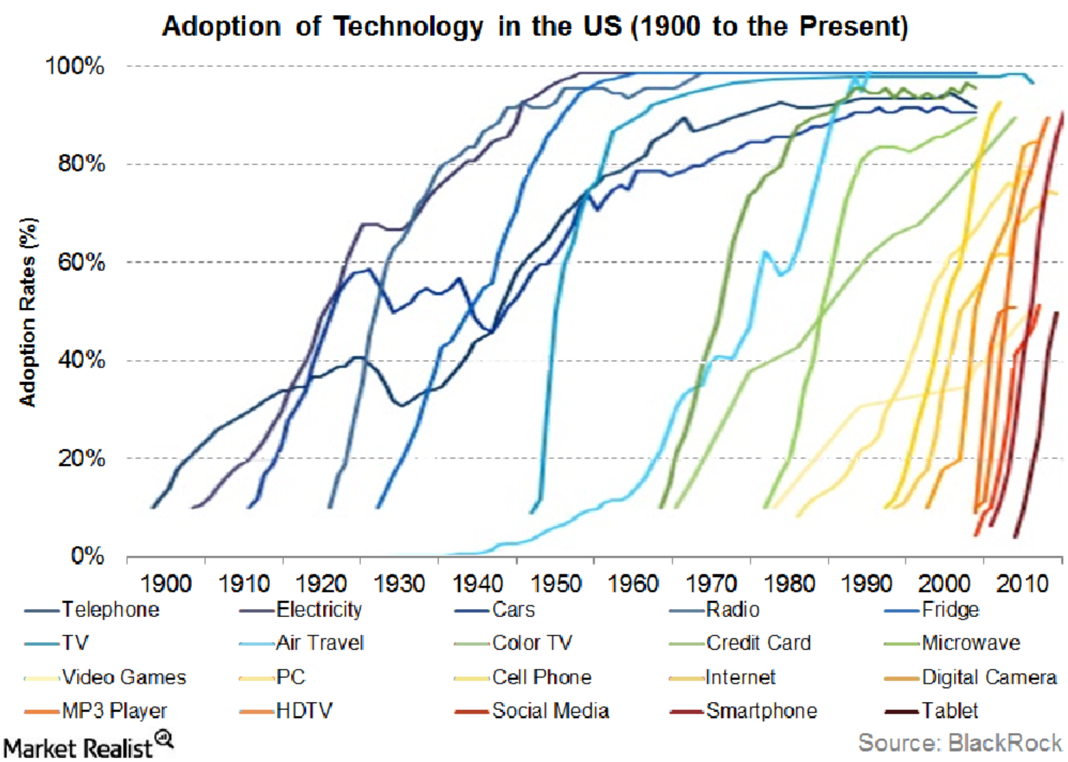

Fig. 4. Recent technologies have shown increasingly steep curves (Rieder, 2015).

Teaching a Doctoral Course in Emerging Information Technologies

A two-semester course on emerging information technologies has been taught in Pace University's Doctor of Professional Studies (DPS) in computing program for the last 20 years. The DPS program "provides IT professionals with a unique opportunity to pursue a doctoral degree while continuing to work full time. It supports interdisciplinary study among the computing disciplines and applied research in one or more areas of the field, providing a background highly valued by both academia and industry. It is an innovative, post-master's, research doctoral program structured to meet the needs of the practicing computing professional" (DPS, 2019). The students come to the university five weekends a semester, roughly once a month, to attend courses and they do additional work between meetings – readings, assignments, teamwork.

The emerging information technologies course sequence is taught in the second-year of the program. Fifteen to twenty students take the course sequence each year and the students are divided into 4-5 person teams. Assessment varies depending on the material covered but usually each team investigates and makes a presentation on an emerging IT topic of current interest, and writes a technical paper to be submitted to our internal computing conference (Research Day Conference, 2019). Because this is an executive program for working professionals, the underlying technical details of the emerging information technologies are not covered in class but teams covering topics in these areas will explore the topics in greater detail. As these areas are explored, the focus is on potential dissertation and discussion material.

The learning objectives of the course are:

1. Learn about important emerging and disruptive technologies and their application.
2. Understand the potential impact on science, engineering, business, and national security.
3. Learn to apply these technologies to their research and engineering projects.
4. Gain an awareness of the ethical issues that decision makers at all levels will face.

Emerging Information Technologies of Current Interest

This section briefly describes many of the emerging information technologies of current interest and explains the distinctions among them. Note that many of these areas of technology overlap.

Artificial Intelligence (AI), Machine Learning (ML), Deep Learning, Data Mining, Data Science, and Big Data Analytics: These technologies are highly overlapping, see Fig. 5. Artificial Intelligence (AI) refers to an artificial creation of human-like intelligence. So far AIs have been in specific narrow areas:

- In 1997 IBM's Deep Blue beat the world's best human chess player
- In 2011 IBM's Watson beat the world's best human jeopardy players
- In 2017 Google's AlphaGo beat the world's best human Go player
- The Google search engine quickly finds information
- Apple's Siri and Amazon's Alexa voice services answer questions

AI has been around for many years and there is currently a renewed focus on Artificial General Intelligence (AGI), AIs that can perform any intellectual task that a human can. Machine learning is a sub-area under AI and deep learning is a sub-area under machine learning. With advances in computing power, applications in these areas can now effectively utilize large quantities of data, thus enhancing the capabilities of data mining and data science that use machine learning algorithms.

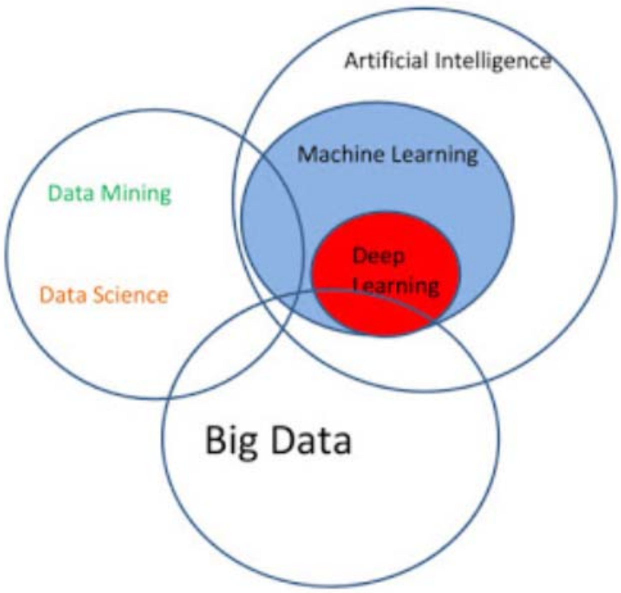

Fig. 5. AI, ML, Deep Learning, Data Mining, Data Science, and Big Data (AI Venn Diagram, 2016).

Deep Neural Networks (DNN), neural networks having multiple layers between the input and output layers (Fig 6), is the newly developed technology of deep learning that is winning most of the contests and outperforming other machine learning technology in most applications, such as in the areas of machine vision and speech recognition (Siri and Alexa), and playing the game of Go (Fig. 7).

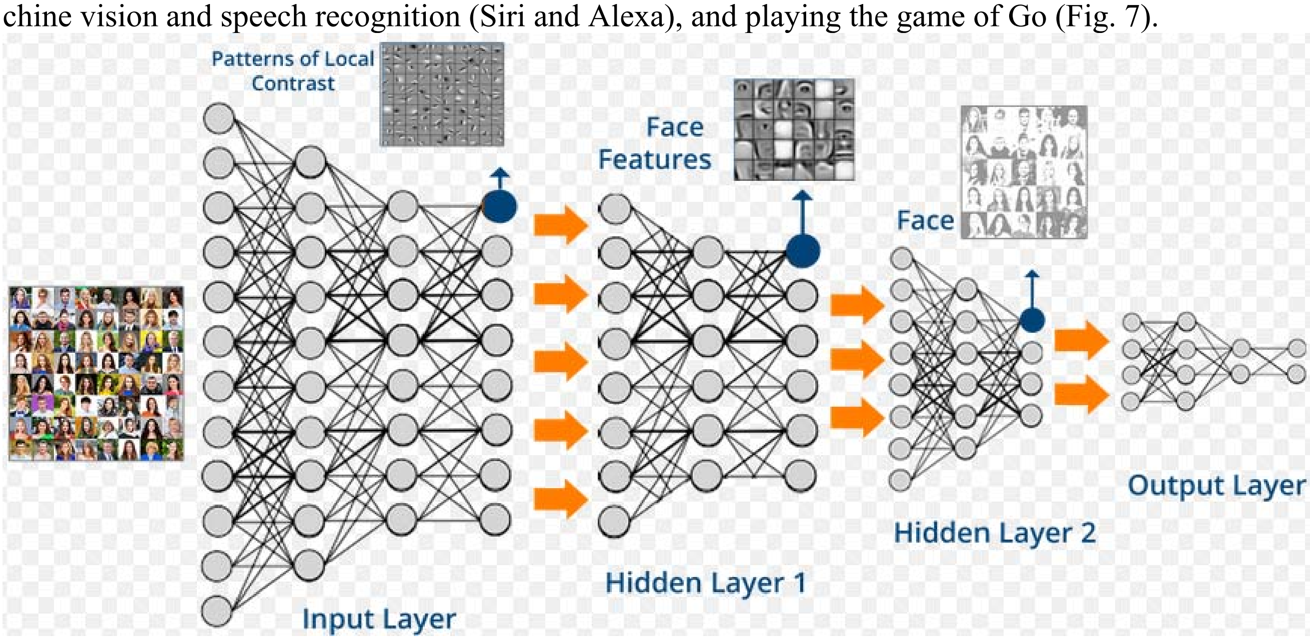

Fig. 6. A Deep Neural Network (DNN) for face recognition (Grigsby, 2018).

Fig. 7. Google's AlphaGo AI wins three-match series against world's best Go player (Phys.Org, 2016).

Other areas of AI are more directly infiltrating our daily lives. Social media has a powerful influence on our lives and increasingly with unintended consequences. McNamee (2019) contends Facebook is creating a political and cultural crisis with a serious danger to democracy, and to support his contention he discusses events like the following:

- 2016 US presidential election and Brexit campaign
    - Cambridge Analytica accessed Facebook user profiles to send targeted ads to influence the election and Brexit
- 2018 MIT study – Twitter fake news is shared 70% more often than factual information
- 2018 United Nations report accused Facebook of enabling religious persecution in Myanmar and Sri Lanka, many were killed

With the soon-to-come driverless cars and humanoid robots we may be on the threshold of an AI-dominated reality. As with many new technologies, there are potential dangers. For example, the predicted "singularity" is said to occur when machines become as intelligent as humans because once that happens they will quickly become far more intelligent than humans causing an unfathomable rupture (singularity) in human experience and could be the end of humanity as we know it today. The Singularity, if it occurs, will be a milestone in AI, not a technology. As to when the singularity might occur, in recent surveys AI experts estimates it could occur with 10% chance by 2022, 50% chance by 2040, and 90% by 2075, and some say it will never occur (Fan, 2019).

Another interesting Venn diagram focusing on the data scientist is shown in Fig. 8. At the center is the perfect data scientist with capabilities in the four areas of communication, statistics, programming, and business. Those with capability in only one of the four areas are the accountant in business, the hacker in programming, the data nerd in statistics, and hot air in communication. An interesting two-area person is the sales person, perhaps the used-car salesman, with capability only in communication and business.

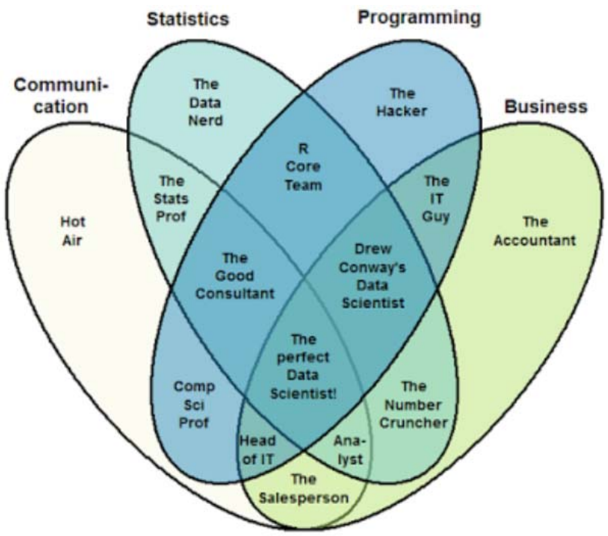

Fig. 8. The data scientist Venn diagram (Big Data, 2016).

Collective Human-Computer Intelligence (Superminds): A supermind is a group of individuals acting together in ways that seem intelligent. Collective intelligence, a property of a "supermind", is the result of groups of individuals acting together in ways that seem intelligent. There are two types of intelligence: specialized intelligence, the ability to achieve specific goals effectively in a given environment, and general intelligence, the ability to achieve a wide range of different goals effectively in different environments. The definition of general intelligence is similar to that used by psychologists and what is measured by intelligence tests (Malone, 2018). A similar breakdown into specialized and general intelligence is also used between artificial intelligence (AI), which today is specialized to a specific task, artificial general intelligence (AGI). The technologies here are core to building "smart spaces" where computers and people interact to solve problems in a variety of environments. A core question is "Can people and computers be connected so that – they act more intelligently than any person group, or computer ever has before" (Malone 2018).

Blockchain: Blockchain is a system that maintains a record of transactions across several computers that are linked in a peer-to-peer network. Blockchain technology has been known as the original digital currency platform since the development of Bitcoin, the first and the largest of the cryptocurrencies. Some companies develop blockchain solutions for other companies. For example, to explore the blockchain area IBM first developed a blockchain solution to transfer money from one IBM facility to another, realizing substantial savings due to the increased speed of transactions. Currently, IBM develops blockchain solutions for banks and other industries – for example, IBM has developed a blockchain shipping solution with Maersk (Fig. 9).

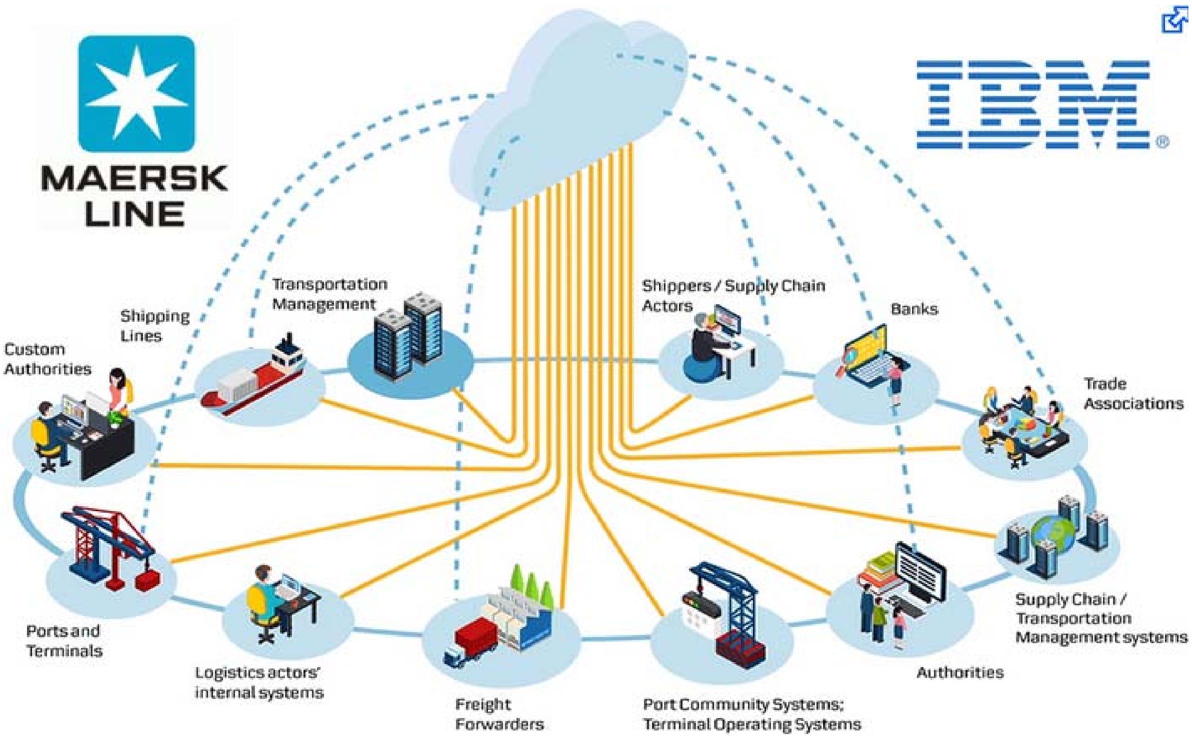

Fig. 9. The 2018 Maersk and IBM Blockchain Shipping Solution (Hannover Messe, 2018).

Quantum Computing: Quantum computing is the use of quantum-mechanical phenomena such as superposition and entanglement to perform computation. There is a quantum computing race among the tech giants Google, IBM, and Microsoft, including to a lesser extent Amazon and China's Alibaba. Governments, particularly America and China, are funding work in the area with the concern that quantum computers may soon crack current encryption methods, giving the country that gets there first a major advantage (The Economist, 2018). Teaching quantum computing at Pace University is described in a companion paper (Tappert, et al., 2019).

Public key cryptography is an asymmetric system using two keys, a public key and a private (secret) key. RSA (Rivest-Shamir-Adleman) is the most commonly used public cryptosystem (Whitman & Mattord, 2003). The keys are related mathematically but the security of the private key depends on the difficulty of computing the private key from the public key. However, Shor's quantum computing algorithm greatly reduces the estimated time to crack the standard RSA encryption method, Fig. 10, essentially by factoring the product of two large prime numbers into their factors. RSA encryption will be cracked once we have reasonably robust quantum computers, currently estimated at 200+ qubit machines with reasonable coherence.

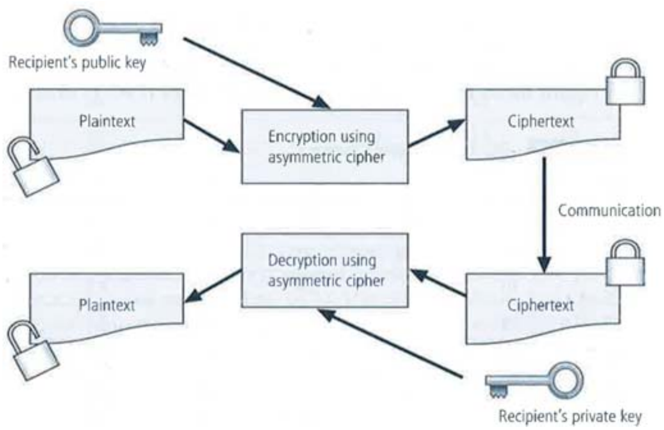

Fig. 10. RSA asymmetric encryption method (Whitman & Mattord, 2003).

Cybersecurity: Cyber security, also called information technology security, concerns the technologies, processes, and practices designed to protect networks, devices, programs, and data from attack, damage, or unauthorized access (Cybersecurity, 2019).

Pace University is a NSA and DHS designated National Center of Academic Excellence in Cyber Defense Education. Funded by NSA and NSF we conduct summer cybersecurity workshops for high school teachers and for high school students. Working with the Department of Defense we offer Information Assurance Scholarships. Working with the National Crime Agency, we conduct mobile application research. We also run a Computer Forensics Laboratory in NYC.

Biometrics: Biometrics refers to the measurement of human characteristics. Biometrics is a common area of research for our doctoral students and our masters-level capstone projects course has had many projects over recent years. We focus on the not-well-studied biometrics because it is easier to do original research and publish results. Understandably, it is hard to compete with companies specializing in the established biometrics, such as fingerprint, face, iris, and voice.

The keystroke biometric involves the authentication or recognition of a typist and Pace University currently has the world's best keystroke biometric system. In the 2016 major biometrics conference, Dr. John V. Monaco, a Pace PhD graduate working for Army Research Labs, overwhelmingly won the Keystroke Biometrics Ongoing Competition, his 15 entries outperformed all the entries from the three other competitors (KBOC, 2016).

Internet Platform Businesses: A new development in the business world is companies based on internet platforms. A platform is a digital environment characterized by near-zero marginal cost of access, reproduction, and distribution. Platform economics, together with Moore's law, and combinatorial innovation continue to reshape industries as dissimilar as computer hardware and recorded music. Major platform companies include: Uber which owns no vehicles, Facebook which creates no content, and Airbnb which owns no real estate (McAfee & Brynjolfsson, 2017).

Conclusions

Teaching emerging information technologies is an area rich with opportunity for growth. Our current course is taught at a high level in our doctoral program for working professionals. Pace University has a business school and in their undergraduate Bachelor in Social Marketing program they just had a new course approved, entitled Emerging Technologies for Business, that our computing school will teach starting in 2020. In addition, we are currently proposing to the computing curriculum committee in our school two new courses in this area. The first course for PhD and advanced masters students is a rigorous computer science course that will cover the underlying theory of these technologies in detail and will have midterm and final exams. The second course at the computer science undergraduate level will cover the highlights of the technologies without going into rigorous detail and is designed to attract and retain undergraduates. This course may be combined with the business school course where project teams would combine computer science and business students with the computer science students performing the technical aspects of the project work (programming, etc.) and the business students focusing on the business aspects of the project work. Teaching emerging technologies is relatively new and our university is creating new courses in this area.

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Experience Teaching Quantum Computing

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Abstract

There is a quantum computing race among the tech giants Google, IBM, and Microsoft, including to a lesser extent Amazon and China's Alibaba. Governments, particularly America and China, are funding work in the area with the concern that quantum computers may soon crack current encryption methods, giving the country that gets there first a major advantage. There are currently about 100 universities worldwide with some activity in quantum computing. Considerable funding is also available and the 2019 U.S. National Quantum Initiative Act authorized $1.2 billion funding over the next 5-10 years. This paper shares the positive experience of Pace University in teaching quantum computing and encourages other schools to join us in this revolutionary step forward for computing. The paper discusses our experiences teaching a graduate-level quantum computing course, teaching the projects component of the course that develops problems to be solved on IBM's Q Experience quantum computing simulator, and teaching quantum computing modules in high schools.

Introduction

There is a quantum computing race among the tech giants Google, IBM, and Microsoft, including to a lesser extent Amazon and China's Alibaba. IBM emphasizes heavy usage on their Q Experience quantum simulator with more than 90,000 users who have run 5,000 experiments and published 110 papers.

Governments, particularly America and China, are funding work in the area with the concern that quantum-computers may soon become large enough (about 200 qubits) and with sufficient coherence to crack current encryption methods, specifically RSA, giving the country that gets there first a major advantage by being able to decipher competitor's communications (The Economist, 2018). At the 2019 Consumer Electronics Show, IBM announced for sale – or, more accurately, calculation time on it -- the IBM Q System One, the world's first commercial quantum computer (IBM, 2019d).

According to the Quantum Computing Report (Fink, 2019), there are currently 91 universities worldwide with some activity in quantum computing. None of these universities currently offers a degree specifically in quantum computing, rather making it an elective course, or at most a specialization in their established physics or mathematics programs. Some universities are planning future investment in the area – for example, the McMahon Lab at Cornell University which emphasizes quantum computation, will officially begin operation in July 2019. In MIT News, a recent article interviewed William Oliver, the principal investigator in both the Engineering Quantum Systems Group at MIT and the Quantum Information and Integrated Nanosystems Group at MIT Lincoln Laboratory. He noted that MIT's quantum computing effort was being inhibited by a shortage of quantum knowledge workers (Leddy, 2019).

The University of Wisconsin is introducing a new Master's program in Physics-Quantum Computing in the fall of 2019. MIT, in addition to its extensive course offering, has a program called xPRO, for online learning, that includes quantum computing units. The University of Maryland has established the Joint Quantum Institute to work with the National Institute of Standards and Technology which is "dedicated to the goals of controlling and exploiting quantum systems" (U of Maryland, 2018). The University of Oregon offers a course subtitled "Quantum Mechanics for Everyone" (U of Oregon, 2017) providing an accessible introduction to quantum phenomena. The following major universities offer courses in quantum computing: MIT, USC, U Michigan, Caltech, Cornell, Harvard, Stanford, UC Berkeley, U Maryland, U Massachusetts, U Minnesota, U New Mexico, U Oregon, Pace, U Pennsylvania, U Rochester, U Virginia, Virginia Polytechnic, and Washington University at St. Louis.

Considerable funding is now available in this area. In the U.S. in January 2019, the National Quantum Initiative Act, authorizing $1.2 billion in investment over the next 5-10 years, was signed into law, and is being organized now into different areas that researchers can apply to for funding in quantum computing (Rep Smith, 2019). An overview of funding opportunities can be found in Appendix A.

This paper shares the positive experience of Pace University in teaching quantum computing at the PhD, Master's, and High School levels, and encourages other schools to step forward and join us in this revolutionary step forward for computing. In the following sections, this paper discusses our experiences teaching the theory of quantum computing in our graduate-level course, teaching the projects component of the graduate course that involves developing problems to be coded and solved on IBM's Q Experience quantum computing simulator, teaching quantum computing modules in high schools, and constructing a simple experimental apparatus to demonstrate some of the nonintuitive behavior of quantum systems.

Teaching a Graduate Course in Quantum Computing

Developed in the fall of 2017, a quantum computing course was offered in the spring of 2018 and again in the spring of 2019 for Computer Science PhD and advanced Master of Science students. This high-level computing course demonstrates that our computing school provides a leading-edge computing technology education to our students. Three faculty members have been teaching this one-semester, graduate-level course in quantum computing for the last two years. The course meets for three hours weekly, in the evening so working students can attend, for a total of 14 weeks over the semester. Two of the instructors, seasoned faculty members with a strong background in mathematics, cover the theory and background material. The third instructor, an adjunct from IBM, handles the student projects concerned mainly with finding interesting problems and creating code to run the problem solutions on quantum computing simulators, primarily the IBM Q Experience. For the first offering of the course, the text *Quantum Computation and Quantum Information* (Nielsen & Chuang, 2010) was employed. However, we felt that the text did not do a good job of introducing mathematical terminology, so for the second offering of the course we used the text *Quantum Computing: A Gentle Introduction* (Rieffel & Polak, 2014). Furthermore, realizing the need for additional math instruction, for this second offering we held separate weekly hour-long sessions of math instruction. Also, since solving problems is an important aspect of teaching the course we adopted, as an auxiliary text, *Problems and Solutions in Quantum Computing and Quantum Information* (Steeb & Hardy, 2018). For the project work in the second offering we used the text *Mastering Quantum Computing with IBM QX* (Moran, 2019).

The course provides the students with an introduction to the theory and practice of quantum computing. Topics covered include quantum computing circuits, particularly quantum gates, and comparison with classical computing gates and circuits; quantum algorithms; mathematical models of quantum computation; quantum error correcting techniques; and quantum cryptography. We also spend a half day during the semester visiting the IBM T.J. Watson Research Center to see actual quantum computers and hear related presentations.

Ten to twenty students take the course – the majority are PhD in Computer Science (CS) students with a few advanced CS Masters students. Assessment is based on the project work and student presentations 40%, midterm exam 20%, and final exam 40%. The final exam also serves as a qualifying exam for the PhD students. The learning objectives of the course are:

- Learn the background material in computer science, mathematics, and physics necessary to comprehend quantum computing.
- Understand quantum computing circuits, particularly quantum gates, and comparison with classical computing gates and circuits.
- Understand quantum Fourier transform and its applications.
- Understand quantum search algorithms.
- Understand the physical realization of quantum computers.
- Understand quantum operations, quantum noise, and quantum error correction.
- Understand quantum information theory and its comparison to Shannon's entropy and traditional information theory.
- Understand in detail the central results of quantum computing.
- Develop a working understanding of the fundamental tools and design methods of quantum computing.
- Develop expertise in writing programming code for quantum computers.

Teaching the Projects Component of the Graduate Course

The quantum computing graduate course has student projects that utilize hands-on labs with simplified quantum program development, live code executions and student projects performed using IBM's Quantum Experience Platform with access to real Quantum Computers. During the first year we used 5 and 20 Qubit computers within IBM Research Labs in Yorktown, NY and Austin, TX locations. This year we are using the IBM Cloud to connect to the IBM Q Network with additional live quantum computers in Tokyo, Japan; Melbourne, Australia; and Santa Cruz De Tenerife Area, Spain.

We used multiple Quantum Computing Science Kits to teach students quantum computing technology. The objective was to help the students to gain practical experience via lab exercises and to develop projects to solve relevant and practical problems using quantum computing algorithm and programs. Details of the QC Science Kits can be found in Appendix B. While initially we used Watson Studio within IBM Cloud, we later deployed a simplified shared development platform based on integrated JupyterHub/JupyterLab virtual machine running within a public cloud service. Details of JupyterHub can be found in Appendix C.

The projects involved three types of problems that were coded using Quantum Computing Assembler Language (QASM) and Python. The programs were then run on quantum computing simulators or actual quantum computers. The first type of problems were well defined quantum computing experiments, including the following:

- Placing qubits in super positions and implementing quantum entanglement
- Implementing "Alice and Bob" example for quantum teleportation, transmitting a qubit's state using two classical bits Implemented "Alice and Bob" scenario for superdense coding, where two classical bits are transmitted using one qubit
- Experiments with 3, 4, and 5 qubit Fourier transforms

The second type of problems were optimizations. We introduced a number of classic quantum computing algorithms and their actual implementation during the graduate classes. Quantum computing can provide solutions to a series of problems that are computationally intensive using classical computers, such as solutions to NP-Hard and NP-Complete Problems (NP: non-deterministic polynomial time). While classic computers use bitwise computations, quantum computers perform unitary transformations on the states of qubits. Using the principles of superposition, entanglement, and quantum parallelism, quantum computers enable implementation of algorithms and computational solutions that were previously not feasible on classic computers. Some of the classic quantum computing optimization solutions demonstrated within the class include:

- Quantum approximate optimization to solve efficiently the classic "Travelling Salesman Problem"
- Grover's Search Algorithm, to solve NP-Complete problem to find the actual solution from a large number of possible candidate combinations.
- Implement simplified quantum programs to solve the Abelian hidden subgroup type problems with a focus on two special cases: Simon's and Shor's algorithms.

The third type addressed practical problems using quantum computing:

- Financial Portfolio Optimization, such as retirement investments, using Variational Quantum Eigensolver (VQE) to find optimal solution to allocate investment dollars across funds.
- Investigate using quantum computing classifiers to optimize computation using kernel methods applied to machine learning projects. Classification methods requiring feature extractions from complex

data can lead to complex kernel computations. These computations cannot be solved efficiently on classical computers. Applied medical image processing with feature extraction and features based classification is common problem. We reviewed an IBM Qiskit tutorial for images-based cancer detection area of applicability: https://github.com/Qiskit/qiskit-tutorials/tree/master/qiskit/aqua/artificial_intelligence

Traffic optimization prototypes aimed to find the best route for drivers within New York City.

As a direct result of what they learned in this course, four papers by students were published at outside conferences. (Westfall, 2018, 2019)(Barabasi, 2019)(Kamruzzaman, 2019).

Teaching High School Students

PhD candidate Avery Leider was impressed by a discussion by a mathematician working on the creation of the IBM Q Quantum Computation Center for commercial clients, which will open in Poughkeepsie, New York in 2019 (Howland, 2019). That mathematician said that the best student to learn quantum computing would not be a PhD or Master's student, but rather a high school student because they are more open to the unusual ideas of quantum computing.

Inspired by that conversation, Avery designed her PhD proposal around the idea of teaching quantum computing to high school students. She developed a curriculum and tested it by teaching quantum computing for five days (January 7 – 11, 2019) in the 12th grade Brooklyn, NY STEAM Center class of high school teacher Damiano Mastrandrea, Pace alumnus MS CS '18. Damiano had observed the first quantum computing course for PhD students during his last semester at Pace and wanted a version of the course for his high school students. The focus was on short lectures followed by hands-on programming utilizing the IBM Q Experience Composer interface to run quantum programs both on the simulator and on the actual machine. For teaching the theory, we found helpful material in *Quantum Computing for High School Students* (Billig, 2018). The module on quantum computing consisted of five days of class.

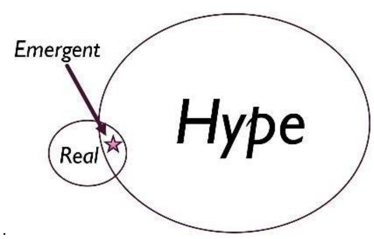

Figure 1: The emergence of Quantum Computing

Day 1 covered the visualization of a quantum bit ("qubit"), introduction to the |ket> notation for vectors in quantum computing, explanation of gates, and an introduction to matrix notation for kets, or vectors, and gates.

Discussion followed about the explosive growth in the science behind quantum computing and the hyperbole in the popular literature about its capabilities. Even excluding the hyperbole, the real discoveries are so advanced and amazing that they border on the fantastic. See Figure 1

An introduction to the concept of measurement was included in this first day. The pre-measurement state, when the quantum computing program is running and the qubit is in a quantum state, was contrasted with the post-measurement state, when the qubits are measured and the quantum waveform collapses and is read as either 0 or 1.

Also covered was the pre-paradigm status of quantum computing. If this was settled science, with a common vision, everyone would use the same terms and same equations. It is such a new science that notations are not standard, and even the order one reads the results – the zeros and ones – of a quantum program are not standard. So flexibility is necessary.

The hands-on portion utilized the IBM Composer, which required all students to register with the IBM Q Experience. The layout of the Composer (Figure 2) was reviewed and the method for selecting whether to run the program on the simulator or on one of the real quantum computers that IBM has made available was explained (Figure 3).

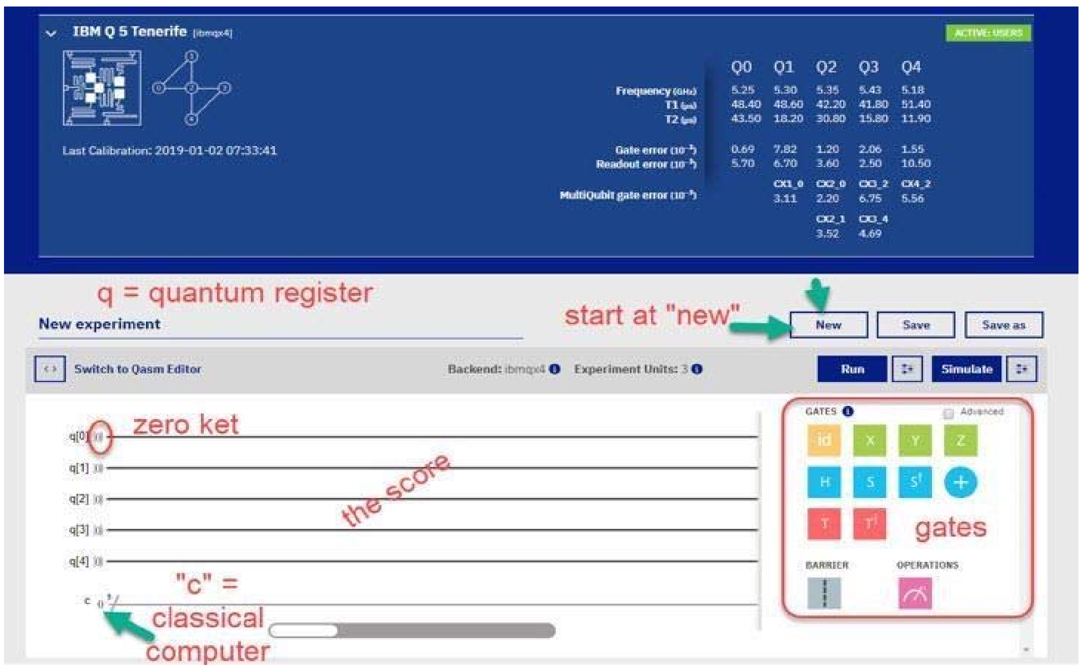

Figure 2: annotated user interface of the IBM Composer

The quantum registers with the qubits in them are listed on the left side, initialized with zero kets, |0>, which is the ground state of a qubit. The qubits are also depicted in relationship to each other on the actual quantum circuit chip in the diagrams of the upper left hand side, see Figure 4. The gate selection menu on the lower right hand side is where the programmer chooses the gate they need and drags it onto the appropriate wire in 'the score'. The selection buttons, for running the program on either the simulator or the actual quantum computing machine are on the right hand side above the gate selection area. The system on which to run the program is selected after the program has been built, named, and saved.

After this orientation, the students went hands-on. The students ran programs demonstrating the X gate which is the quantum equivalent to the classical NOT gate. If the qubit is in a ground state with value 0, then putting it through an X gate flips it into the 1 state, the activation state, and vice versa. Students reviewed the results – the zeros and ones – which were read from right to left, as if they were Chinese characters. Also important was the understanding that the results in a quantum program are delivered in probabilities. Quantum programming does not deliver exact results, so each quantum program is run many times in order to give a probability distribution. On a simulator, a program might be run 100 times to give a good result, whereas on the real machine, it may take 1,024 or more executions to give a reasonable distribution.

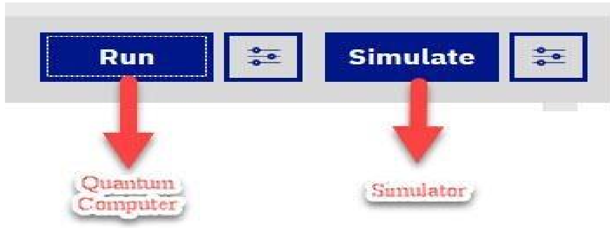

Figure 3: Click "Run" for a quantum computer or "Simulate" for the simulator.

Day 2 covered superposition and entanglement. To understand the diagrams illustrating superposition, they had to be introduced to the Greek symbol psi, Ψ, as superposition can be shown as a psi Ψ |ket> (to show all of the possibilities, psi Ψ, of a vector |ket>, in superposition: the psi-ket is depicted as |Ψ>). The |Ψ> vector can move in multiple dimensions, which is hard to describe and hard to show in an illustration. Superposition is created by applying a Hadamard (H) gate to a qubit.

After superposition was firmly understood, entanglement was explored. Entanglement means that two or more qubits have formed a relationship. The entanglement is created by the program applying an H gate to the one qubit and then a Controlled-Not (CNOT) gate to two qubits. The qubit that had the H gate applied is the control qubit and the second qubit is the target qubit. They can be separated by large distances, yet always remain entangled with one another – if one is changed by a new gate, the other changes instantly in the same way. At this point the students protested that this would violate the law of physics that nothing can have a velocity greater than the speed of light (c). It was explained that there is no violation because there message noting that the change occurred is still limited by c.

The hands-on portion of the class was to make 6 CNOT connections in the IBM Composer, use X gates (X gates flip values from zero to one and one to zero), to predict their answers, and run the program. To do this, the students had to study the diagram that accompanies the programming interface of the Composer, to identify legitimate paths for entanglement of qubits, see Figure 4. A legitimate path of qubit entanglement goes from qubit 1 to qubit 0 or 2 or from qubit 3 to qubit 4 or 2. An attempt to put a CNOT gate between other combinations of qubits, such as between 1 and 3, will not be allowed and in the Composer, the disappearance of the incorrect CNOT from the program.

Figure 4: Five Qubit IBM Quantum Computer

Day 3 covered Grover's Algorithm. This is an important search algorithm with great potential to help many industries. It is a uniquely quantum algorithm, not found using classical computers. To understand Grover's Algorithm, the high school students first had to review the action of the H gate plus the CNOT gate in entanglement, and then understand the pattern of the gates – the two circuits formed by gates - that form the two parts of the Grover's Algorithm. The first part is the Oracle that highlights the item being searched for. The second part is the Amplifier, which boosts the value of the highlighted result.

At low signal, the right answer does not clearly show in the probabilities distributions. After amplification the right answer is apparent.

There is an IBM tutorial at the Q experience that demonstrates Grover's Algorithm on their real world working IBM computer. However, the program failed, with the error message "You can't put a gate there" and the turnkey setup revealing a program missing its most essential components – the CNOT gates of entanglement, leaving orphaned H gates. The program was run on the quantum computer, but the results did not provide a valid solution to the problem. The students were grouped into troubleshooting teams to find and fix the problem. This was the most engaging part of the instruction, as the students, having only two days of quantum computing, got a chance to troubleshoot a real quantum computing program. The first team to solve the puzzle did so in 20 minutes, while the last of 5 teams solved it in 40 minutes. The answer was to look at the IBM circuit board diagram for the IBM computer that the program was being run on. Every quantum computing program has to take into consideration the exact construction of the specific individual IBM computer's unique hardware when making CNOT connections. Some connections are not physically possible. The author of the IBM tutorial on Grover's Algorithm must have used a different computer configuration. Once the problem was found, the students had to add back the CNOT gates that had been omitted, and then rerun the program. The troubleshooting process encouraged active participation of the students with a lot of animated discussion of how to solve the problem. Because of the time spent troubleshooting the problem and fixing it, the objective of Grover's Algorithm was neglected. This omission was revealed during review the following day.

Day 4 returned to the subjects of Superposition and Entanglement. Review of Superposition included the Bloch Sphere as an illustration of a qubit, and the |Ψ> vector within that sphere with its nearly infinite possibilities between zero and one. There was a brief introduction to the Bell States as the primary examples of entanglement.

.A hands-on exercise followed that tested executing one superposition and its results – which are 50% one and 50% zero. Then the students tried two Hadamard gates in a row. Because the Hadamard gate is its own inverse, the second gate undoes the action the first gate and returns the input to its original state. The result was not one, but close to one, demonstrating that there is randomness in quantum computing. There was open discussion about how entanglement, as utilized in a quantum computer, can be used to solve problems.

A general survey introduction then discussed the few quantum algorithms available, such as Grover's Algorithm and Shor's Algorithm. The discussion of Shor's algorithm went into RSA encryption briefly, as Shor's algorithm may be used to factor the product of two primes, which is central to RSA encryption. This was followed by a lighthearted discussion of Schrodinger's cat and a search for images of Schrodinger's cat that each team shared with the class.

On **Day 5**, the students were split into teams and each team was given one day's worth of PowerPoint slides from the instructor. This was an exercise they were familiar with, and they called it the "Jigsaw Puzzle". They reworked the PowerPoint slides into their own slides. Then each team presented their slides to the class. This was a good opportunity for them to demonstrate and reinforce what they learned and for the instructor to get ideas on how to improve the class. Also on Day 5 the students completed a survey and ranked topics of most interest (Figure 5).

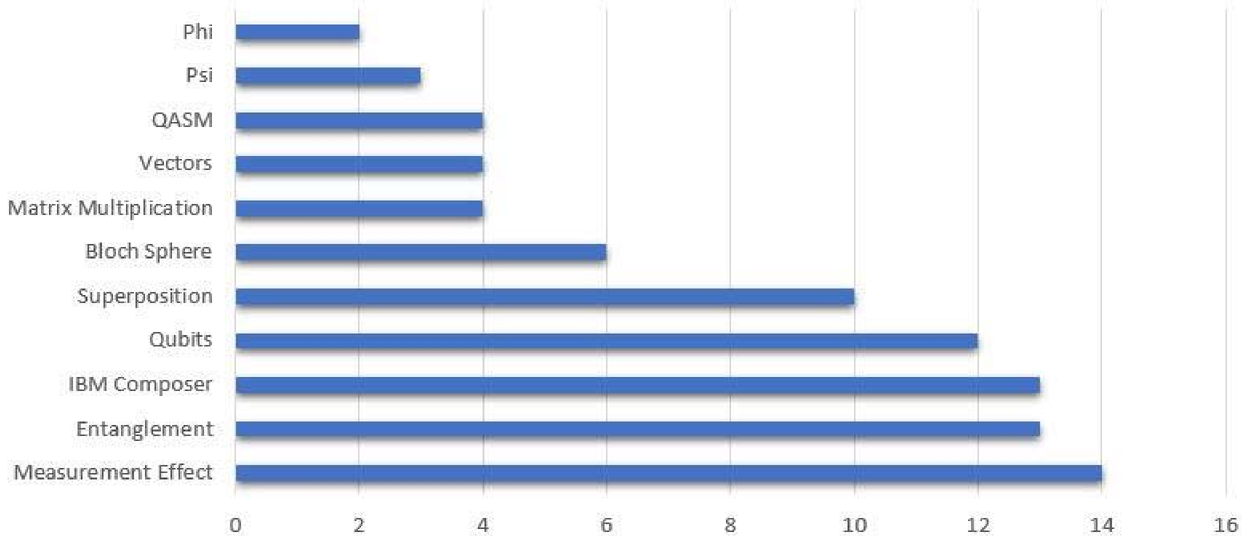

Figure 5. Topics the students found most interesting.

Each day, two assistant teachers supported the instruction by capturing student questions, compiling and displaying them on PowerPoint slides. The questions were answered at pauses in the instruction with the students being offered the opportunity to answer their classmate's questions first, with encouragement and clarification provided by the instructor. The student questions show a remarkable understanding of quantum computing in a very short amount of time, and also show that there where misunderstandings caused by an awkward use of an analogy of sound waves and quantum mechanics waves. These are two different kinds of waveforms that are not related, but that share similarities in the mathematics used to understand them. The opportunity to review the ideas understood by the students in front of them helped straighten out some of these misunderstandings.

Demonstration of Nonintuitive Behavior of Quantum Systems

Quantum computing is a beautiful combination of quantum physics, computer science, and information theory. Qubits (quantum bits) are the fundamental units of information in quantum computing, as bits are fundamental units in classical computing. Just as there are many ways to realize classical bits, there are many ways to realize qubits, and polarized photons are a possible realization of qubits. Here we describe a simple experimental apparatus constructed to demonstrate some of the nonintuitive behavior of quantum systems, in this case of systems involving polarized photons. This experiment was described by Rieffel & Polak (2014) to illustrate the behavior of polarized photons and they specify the minimal equipment required as a laser pointer and three polarized filters (polaroids) available from any camera supply store (Figure 6, top). Because it is difficult to have students hold the laser pointer, three filters, and the screen, we found it more convenient to use a laboratory rack to hold these items (Figure 6, bottom).

The demonstration is conducted as follows.

.Remove all items from the rack except the laser pointer and the screen

.Shine the laser beam of light on the projection screen

.Place polaroid A between the light source and the screen to show a reduced light intensity reaching the screen, and rotate it to filter horizontally so that only horizontally polarized photons pass through the filter

- Place polaroid C between polaroid A and the projection screen and rotate it initially to also filter horizontally to show the maximum unreduced light on the screen
- Slowly rotate polaroid C to show that the light hitting the screen is reduced until the light is completely blocked when polaroid C filters vertically to block the horizontally polarized photons allowed through polaroid A
- Finally, insert polaroid B between polaroids A and C, and rotate B slowly to allow light to pass and hit the screen

Because the insertion of polaroid B surprisingly increases the light intensity on the screen, the polaroids cannot be acting as simple sieves. Although the results of this experiment can be explained classically in terms of waves, the same experiment can be performed with more sophisticated equipment using a single-photon emitter to yield the same results which can only be explained with quantum mechanics. And it is not just light but many other quantum phenomena that behaves in this peculiar way.

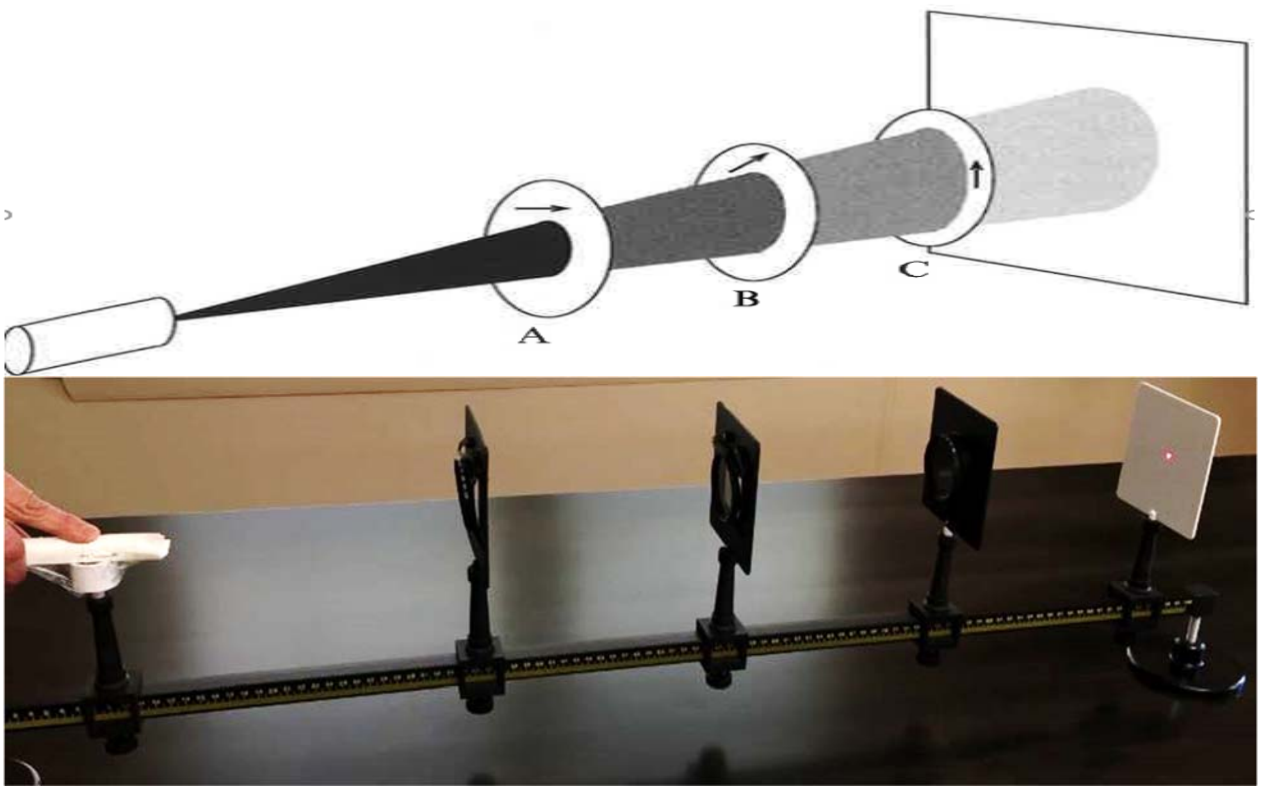

Figure 6. Rieffel & Polak (2014) textbook figure (top) and Pace University apparatus (bottom).

Conclusions

Because of the quantum computing race among the tech giants and the realization that computers may soon crack current encryption methods giving the country that gets there first a major advantage, there is a growing need to teach quantum computing technology at all levels of education from high schools through graduate schools. There are currently many universities worldwide with some activity in quantum computing and considerable government funding is available. This paper shares the positive experience of Pace University in teaching quantum computing and encourages other schools to join us in this revolutionary step forward for computing.

In this paper, we have discussed our experiences teaching a graduate-level quantum computing course that includes the development of problems that can be solved on IBM's Q Experience quantum computing simulator, teaching quantum computing modules in high schools, and how to construct an experimental apparatus to demonstrate some of the nonintuitive behavior of quantum systems. We also anticipate offering an undergraduate course in quantum computing in the near future. Teaching quantum computing is an area rich with opportunity for growth, for funding from the federal government, and for employment for our students. It may also strengthen our nation's economic future. Quantum physics is a challenging subject, but the quantum computing that uses it, does not have to be difficult to teach.

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Appendix A - Overview of Funding Opportunities

A two-page overview of Federal Quantum Information Science was published by the Congressional Research Service in July 2018 (Congressional Research Service, 2018). It is a snapshot of federal efforts at that time, and includes views on international efforts. It is a good starting point for understanding federal efforts in the area of quantum computing. A more detailed overview is the National Strategic Overview for Quantum Information Science, published in September, 2018, by the Subcommittee on Quantum Information Science, under the Committee on Science of the National Science and Technology Council (Executive Office of the President of the United States, 2019). Also in September, 2018, the Department of Energy announced $218 million funding for efforts in Quantum Information Science. The DOE's Office of Science has three program offices for Advanced Scientific Computing Research, Basic Energy Sciences, and High Energy Physics awarding grants. The ASCR lists award opportunities on its Funding Opportunities web page (DOE, 2018).

The National Science Foundation has been active in awarding quantum research grants for some time. In September 2018, the NSF announced awards in two efforts with the awards going to twenty-seven US universities.

- $25 million for exploratory quantum research as part of the Research Advanced by Interdisciplinary Science and Engineering (RAISE)-Transformational Advances in Quantum Systems (TAQS) effort.
- $6 million for quantum research and technology development as part of the RAISE-Engineering Quantum Integrated Platforms for Quantum Communication (EQuIP) effort.

The NSF promotes 10 Big Ideas, research areas deemed critical for US technological leadership. The NSF has plans in 2019 to invest $30 million in each Big Idea. Quantum Leap is one of these 10 Big Ideas. The Quantum Leap web page (NSF, 2018) describes the effort as "Exploiting quantum mechanics to observe, manipulate, and control the behavior of particles and energy at atomic and subatomic scales, resulting in next-generation technologies for sensing, computing, modeling, and communicating."

In response to the National Strategic Overview, on December 11, 2018, the NSF issued a Request For Information, with responses due January 25, 2019, asking for "…information from the research and development community around quantum information science (QIS) to inform the subcommittee as the Government develops potential means of addressing specific policy recommendations."

Specific questions contained in the RFI (RFI, 2018) are indicative of the government's desire to be guided by the quantum community as it tries to encourage the development of quantum computing.

In a December 20, 2018 article in Forbes, Alex Knapp wrote about the new National Quantum Initiative Act (Knapp, 2018), "On Wednesday, the House of Representatives voted 348-11 to adopt a bill aimed at accelerating the development of quantum computing. The bill, dubbed the National Quantum Initiative Act, passed the Senate last week unanimously, and President Trump is expected to sign the legislation, which will add the U.S. to the mix of powers such as China and the EU that are pursuing their own coordinated strategies to accelerate this technology."

On December 21, 2018, H.R.6227, the National Quantum Initiative Act, became law (Rep Smith, 2019). The bill defines "quantum information science" as the storage, transmission, manipulation, or measurement of information that is encoded in systems that can only be described by the laws of quantum physics. It directs the National Science Foundation to award grants for Centers of Quantum Research and Education. A search for NSF grants begins on the NSF web site's Funding page (NSF, 2019). From there, the "Browse Funding Opportunities A-Z" link will access a list of quantum computing funding possibilities:

- **Q-AMASE-i** - Enabling Quantum Leap: Convergent Accelerated Discovery Foundries for Quantum Materials Science, Engineering and Information (Q-AMASE-i)
- **QCIS-FF** - NSF Quantum Computing & Information Science Faculty Fellows (QCIS-FF)
- **QII** - Enabling Quantum Leap: Quantum Idea Incubator for Transformational Advances in Quantum Systems (QII - TAQS)
- **QLCI** - Quantum Leap Challenge Institutes (QLCI)
- **Quantum** (general)
- CISE-MPS Interdisciplinary Faculty Program in Quantum Information Science
- Enabling Quantum Leap: Convergent Accelerated Discovery Foundries for Quantum Materials Science, Engineering and Information (Q-AMASE-i)
- Enabling Quantum Leap: Quantum Idea Incubator for Transformational Advances in Quantum Systems (QII - TAQS)
- Ideas Lab: Practical Fully-Connected Quantum Computer Challenge (PFCQC)
- NSF Quantum Computing & Information Science Faculty Fellows (QCIS-FF)
- Quantum Information Science
- Quantum Leap Challenge Institutes (QLCI)

Each of these links will access further information about the research opportunity, including specific requirements, amounts, and dates. There is also a "Find Funding" link which provides a keyword search facility. On February 17, 2019, the word "quantum" returned 37 active funding programs. One would expect that in the coming months, the National Quantum Initiative Act will add to the funding opportunities already available for quantum computing research. The federal websites should be closely monitored for these opportunities.

Appendix B - QC Science Kits

These QC Science Kits include:

- IBM contributed and moderated community project Quantum Information Science Kit (QisKit) available at https://github.com/qiskit
- Quantum Toolbox in Python (QuTIP) moderated by QuSTaR (www.qustar.org)
- Investigated Rigetti's SDK package, with focus on its Python pyQuil package and Quantum Virtual
- Machine (QVM), which is an open-source implementation of simulator as a quantum abstract machine (QAM) using classical computer hardware.

In addition to Quantum Computers, we used multiple Quantum Computing simulators provided by IBM:

- The 32-qubit IBMQ-QASM-Simulator via IBM Cloud

- Custom deployed HPC-Quantum-Simulator and made it available for students with the goal to help them avoid job-queue wait times for having their code be processed by IBMQ devices. We have custom implemented this simulator using a large-size virtual machine, available 24/7 for students use.
- Local simulators available within QisKit, such as simplified traditional simulator and the experimental release of the QisKit Aer high-performance simulator framework

Appendix C - JupyterHub

The benefits of JupyterHub type deployment of the teaching environment were the following:

- Leveraged enhanced IDE using JupyterLAB and a number of extensions, such as Google Drive, Github and other plugins.
- We have pre-installed multiple Quantum Computing Science Kits, such as QisKit, QuTIP and others.
- We have pre-installed additional required python libraries, such as matplotlib draw, latex draw, IBMQ provider, PDF exporters and other circuit visualization add-ons.
- Simplified faculty's work to assist and help students with their Jupyter notebooks, python programs and code artifacts. This platform empowered students become self-sufficient with QC science kits, creating quantum circuits and developing programs for implementing specialized algorithm in context of the studied class topics.

Appendix D - IBM Composer

The benefits of IBM Composer used with the high school teaching environment were the following:

- IBM Composer is all on the web, so it took only the one step of having the high school technical support security policy decision maker to make the URL available. The students could get hands-on with the tool right away after IBM registration, which took only minutes.
- IBM Composer includes descriptions of the gates, includes QASM, and includes a diagram of the arrangement of the qubits in the quantum computer being programmed. The User Interface is intuitive, at least, to a high school student. Well-placed error messages, such as a reminder to save the program before running it, pop-up to assist.
- Quantum programs written in IBM Composer can be run on either real quantum computers or on the simulator. Sometimes at periods of high traffic, the real quantum computers delayed giving their results by a few hours or a day. Also, on common programs (such as those following the online IBM Composer tutorials), an option to accept the results of previous identical code that was run on the quantum computer, that is still in cache, will be offered. Simulator results are instantly delivered. For the classes given to the high school students, running the programs on the real machine were limited to where it made a significant difference in the results. The simulator also offers a range of configuration options and that can be designed by the student to try different ideas.

Parsing the Acronyms of User-Centered Design

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Abstract

As a value and end result of the user-centered design (UCD) process, user experience (UX) is constantly evolving alongside of the users with which it is concerned. Faculty, staff, and other professionals in higher education attempt to meet the academic, economic, and ability needs of students by conducting usability testing and other user research, investing in open access (OA) and open educational resources (OER), and evaluating the accessibility of the physical and virtual services and products they currently provide or are considering. This paper will present the language used to describe UCD, as it applies to higher education, by examining the apparent overlap between UX and instructional design (ID), which leads to the concept of learner experience (LX), and the larger conversations on assessment and inclusion through universal design (UD) for college and university learning and teaching.

Introduction

Whether serving as faculty librarian, instructional designer, instructional technologist, tenure-track or adjunct professor, or even chief information or technology officer, professionals in higher education, these days, are inundated with acronyms when researching, designing, and evaluating the instructional and/or technological experiences of their users. While this is nothing new for librarians and other faculty and staff working directly with educational and emerging technologies, for some college and university employees, it can be overwhelming to parse the alphabet soup associated with user-centered design (UCD), let alone apply it to their everyday work. Based on recent professional literature and anecdotal evidence, however, it appears that administrators are beginning to realize the benefit of a user-centered approach. The renewed interest, and in some cases, campus-wide emphasis in meeting the academic, economic, and ability needs of students through investment in programs supporting instructional design (ID), learner experience (LX), and universal design (UD) is a sign of the times, suggesting a slight shift or, perhaps, expansion of focus from the culture of assessment, which has been widely discussed in professional librarianship in recent years, to the culture of usability or, more broadly, user experience (UX). This paper will present the language currently used to describe UCD in higher education.

Understanding UCD and Service Design

First, we need to identify the essential components of the UCD process in order to establish its place in higher education and its relationship to UX. According to the definition provided by Usability.gov, managed by the U.S. Department of Health & Human Services, the UCD process "outlines the phases throughout a design and development life-cycle all while focusing on gaining a deep understanding of who will be using the product." While there are no prescribed methods for UCD in general, there are many variations of the UCD process, some more complex and detailed than others. The "waterfall" approach, for example, outlines the key phases as Plan, Analyze, Design, and finally, Test and Refine, all of which contain steps focused on usability and UX (see Figure 1). Other models are more simplistic, and yet, still emphasize the iterative nature of the UCD process (see Figure 2), making their similarities and connections to ID or instructional systems design (ISD) models even clearer.

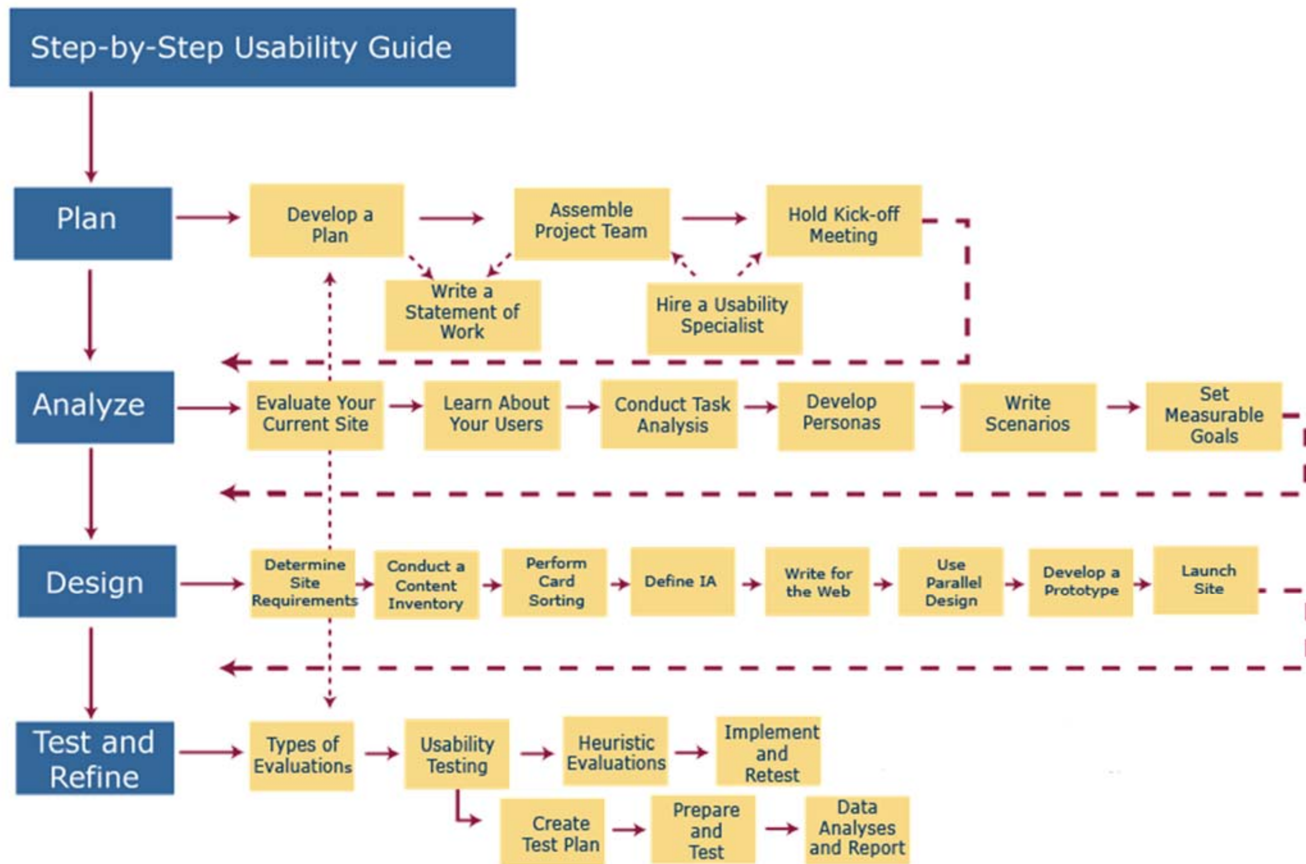

Figure 1. UCD Process (Usability.gov)

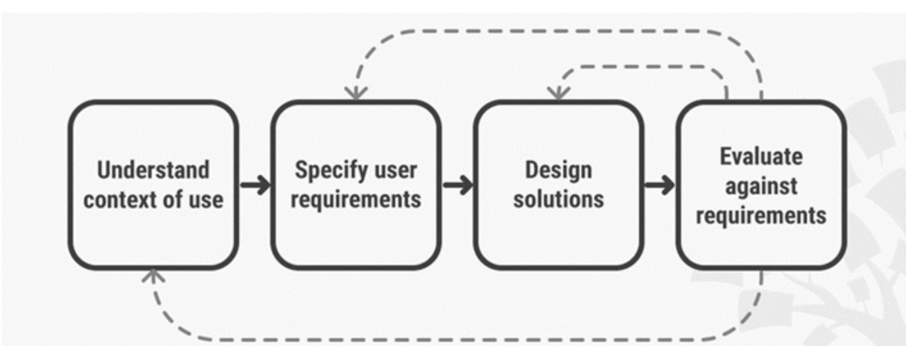

Figure 2. UCD Process (Interaction Design Foundation)

As a value or end result of the UCD process, which originally gained traction following publication of two books by cognitive scientist Don Norman, who is also one of the cofounders of the Nielsen Norman

Group—*User-Centered System Design: New Perspectives on Human-Computer Interaction* (1986) and *The Design of Everyday Things* (1988)—UX, by design, is constantly evolving as a discipline or field and, with any luck, improving alongside of the users with which it is concerned. UX, as described by Norman & Nielsen, "encompasses all aspects of the end-user's interaction with the company, its services, and its products." In the case of higher education, the "company" would be the college or university, but the "interaction" extends far beyond the usability of our "services" or "products." Regardless of the apparent, as well as the more latent, motives to serve our users, in order to fully understand the compatibility of UX with the missions and goals of higher education, we must also carefully consider its "facets" or qualities, as illustrated by Peter Morville (2014). With Valuable placed at the center of the "honeycomb," Morville's diagram indicates that instructional and/or technological experiences should be rated based on how Useful, Usable, Desirable, Findable, Accessible, and Credible the users find them to be (see Figure 3). With these definitions and descriptions in mind, it is easy to see how UCD may affect the UX of students and vice versa, but as Rebecca Blakiston insists in her book, *Usability Testing: A Practical Guide for Librarians* (2014), in order to be effective, assessment or evaluation of these qualities must be "conducted in an ongoing, systemic way."

Figure 3. User Experience Honeycomb

Secondly, we need to understand service design in higher education. Establishing the roles of users and service providers is integral in the design thinking process, particularly during the initial Empathize and Define steps (see Figure 4) as explained by Nielsen Norman Group Chief Designer Sarah Gibbons (2019), which are concerned primarily with the experience of the users as well as their needs. Within the scope of this paper, the users are assumed to be college and university students, while faculty, staff, and other professionals are assumed to be the providers, or facilitators, of instructional and/or technological services and products that assist or support the users. Before we can begin the Ideate, Prototype, and Test steps (see Figure 4), however, we must commit ourselves to observing, understanding, and thinking about problems with our services and products as recommended by Joe J. Marquez & Annie Downey in their books dedicated to the methods and mindset of service design and evaluation—*Library Service Design: A LITA Guide to Holistic Assessment, Insight, and Improvement* (2016) and *Getting Started in Service Design: A How-To-Do-It Manual for Librarians* (2017). According to Marquez & Downey's work, everything that is experienced by users is evaluated as a service, including instructional materials and products, both physical and virtual, offered by service providers. Marquez & Downey have even gone so far as to develop and disseminate, as part of the American Library Association's 2017 Future of Libraries Fellowship, score cards for heuristic analysis of services (see Figure 5). These cards instruct and assist service providers as they holistically assess the following criteria: Meeting Current Needs and Expectations, Consistency of Service Delivery, Consistency of Communication, Context Appropriate, Acceptable Interaction Costs (or Ease of Use), Empower User Autonomy, Reasonable Duration and Tempo, Welcoming, Accessible, and Clarity of Purpose and Function.

Figure 4. Design Thinking (Interaction Design Foundation)

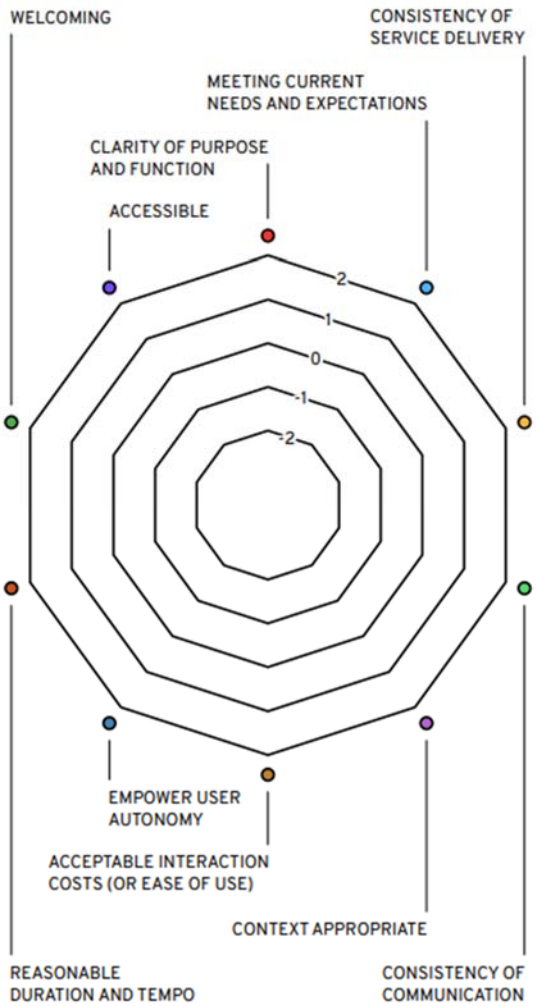

Figure 5. Library Service Design Heuristics Card

Clearly, design thinking and service design are both mindsets in addition to actual processes by which service providers in higher education may learn more and even co-create better experiences alongside of users inside and outside of the classroom. In an effort to "move towards a more thoughtful and inclusive assessment practice," Ebony Magnus, Jackie Belanger & Maggie Faber (2018) report turning to UX approaches such as participatory design by "inviting [sic] users into projects as experts as well as participants, and relying on their interpretation and recommendations to guide data analysis." This effort to include users in both the evaluation process and the analysis of results marks a key difference between assessment as it is commonly performed on college and university campuses, usually in the form of an anonymous survey or questionnaire, which is designed to demonstrate accountability, impact, and/or value to administration, and ongoing and iterative usability testing and other user research, which is designed for improvement. As concluded by Krista Godfrey (2015), service providers "cannot meet user needs without talking to and observing users in their spaces, both physical and virtual." Traditional assessment tools, like surveys and questionnaires, that emphasize or, perhaps, reluctantly depend on quantitative versus qualitative data collection, are in many ways insufficient and antithetical to authentic assessment of the instructional and/or technological experiences of users.

Designing Services and Products

Last but not least, we need to acknowledge the practical application of the UCD process, and even service design, already present on college and university campuses. Providers, or facilitators, of instructional and/or technological services and products in higher education currently attempt to meet the academic, economic, and ability needs of users in a variety of ways. By creating, conducting, and analyzing the results of usability testing and other quantitative and qualitative user research, they set out to learn more about the experiences, needs, and wants of students. While the “culture of assessment” appears to be alive and well in higher education, placing accountability at the forefront of our efforts to improve UX, there is still work to be done in terms of using collected data to inform decision making. According to research conducted by Meredith Gorran Farkas, Lisa Janicke Hinchliffe, & Amy Harris Houk (2015), support and prioritization of a “user-focused” culture, at least in “academic libraries at four-year institutions in the United States,” depends greatly on the willingness of administration to make change based on UX assessment or evaluation. Likewise, though focusing only on learning and teaching, Claudia J. Stanny (2018) suggests that an evolution to a “culture of improvement” is possible if institutional leaders provide opportunities for faculty to participate in professional development dedicated to assessment work. Another way in which service providers, and their administrators, attempt to meet user needs is by investing in open access (OA) and open educational resources (OER). While “investing” may seem an unlikely word to use in discussing efforts to replace expensive textbooks and various proprietary software subscriptions with open, low or no-cost course materials, on some college and university campuses, money is most definitely exchanging hands, primarily in the form of incentive grants or stipends, in order to promote faculty adoption of OA and OER, and professional literature on the topic, especially that which includes collaboration between faculty librarians, instructional designers and/or technologists, and professors, is overwhelmingly positive. Finally, service providers are, or at least should be, in compliance with the American Disabilities Act, regularly evaluating the accessibility virtual services currently being used and those being considered for future use—though not necessary implementing usability testing detailed in Steve Krug’s book *Don't Make Me Think: A Common Sense Approach to Web Usability* (2000). This extends beyond the appropriate use of HTML alt tags and headings, color contrast, and closed captioning. When we discuss accessibility within the scope of UX, we are really talking about universal design (UD), which includes physical services and products experienced by the user, and this conversation leads us to back to UCD and its connection to ID or ISD.

Learner experience design (LXD or LX) is a somewhat new yet logical, and potentially revolutionary, combination of ID and UX. Instructional designers, of course, take a user-centered approach when researching, designing, and evaluating experiences for learners, and their field has a couple of tried and true models for service and product design and development. The ADDIE model, for example, presumably starts with Analysis and ends with Evaluation (see Figure 6). Likewise, the Dick and Cary model for ISD “starts” with Identify Instructional Goals, which includes Conduct Instructional Analysis, and “ends” with Develop & Conduct Summative Evaluation, which ideally informs the next cycle of ID (see Figure 7). Both models are cyclical and iterative to an extent, and as previously mentioned, UX research and design is ongoing and always evolving alongside of the users with which it is concerned. In both ID and UX, the ultimate goal is to systematically improve student and/or user engagement and/or experience, and thanks to rapid development in educational and emerging technologies, learning and teaching tools are evolving as well. “The transition to virtual content has made entirely new layers of student data available,” writes iDesign Cofounder and Chief Academic Officer Whitney Kilgore (2016), “Learners now leave a virtual footprint that allows designers to understand how students are interacting with course materials and for how long.” While it takes some imagination to combine ID and UX, it is fairly natural synthesis, especially when comparing the ways in which we currently measure success in each of these fields. Assessment, insight, and improvement of virtual services and products as described by Kilgore (2016), however, is not sufficient UX. We also need to evaluate physical services and products, the in-person instructional and/or technological experiences of users, and LMS data analysis, however advanced, will not provide a full picture of our users and their needs. In order for the UCD process to be effective, it is imperative that we design and develop services and products universally and with all potential users in mind. “Because disability is always intersectional and accessibility has more radical potential than at first glance,” Stephanie Rosen (2017) explains, “accessibility can be a powerful tool for justice.” Whether LX is simply an evolution of ID or, perhaps, a revolution is still up for debate, but its connection to UCD, accessibility, and inclusion is clear.

Figure 6. ADDIE Model (Educational Technology)

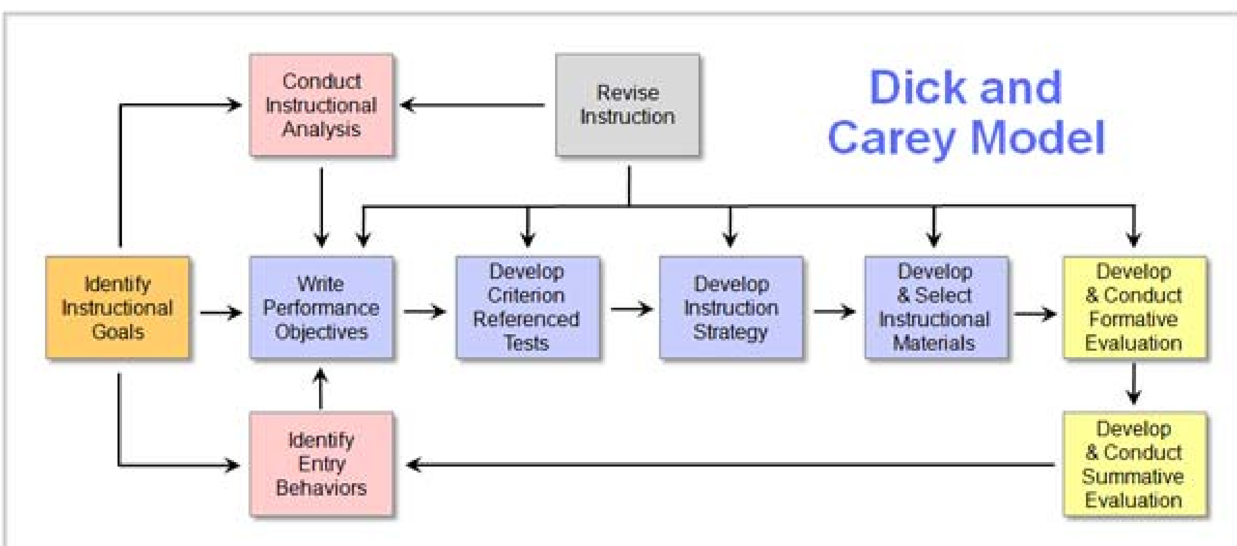

Figure 7. Dick and Carey Model (Educational Technology)

Conclusion

While the language used to describe UCD varies and continues to evolve with its users, the overlap between ID, the concept of LX, and the larger conversation of inclusion through UD for college and university learning and teaching is apparent when considered within the scope of UX. Whether serving as faculty librarian, instructional designer, instructional technologist, tenure-track or adjunct professor, or even chief information or technology officer, professionals in higher education, these days, are inundated with acronyms when researching, designing, and evaluating the instructional and/or technological experiences of students. Despite the difficulties we may have implementing best practices, it is worth the time and effort it takes to explore frameworks and seemingly interdisciplinary models that could possibly improve services and products at our institutions, and it is important to avoid viewing renewed efforts to meet the academic, economic, and ability needs of students as "trends." Based on recent professional literature as well as anecdotal evidence, it appears that administrators are beginning to realize the benefits of the user-centered approach, and parsing the alphabet soup associated with UCD is just the start. Moving forward, we must evolve from a "culture of assessment" to one focused on using ID and UD processes and concepts to improve LX and UX.

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Comparing Course Delivery Methods, What do Students Prefer and What Works

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Abstract

In the past eleven years we have developed several papers for ASCUE about hybrid classes. The initial paper we shared our experience developing a hybrid course and followed with comparisons of student opinions about face-to-face, hybrid, and online classes and finally a paper reviewing components that we were using in hybrid and online classes. It has been eight years since we last addressed the topic, in that time, we have gone from using no online classes and limited use of hybrid courses to relying on their availability in order to deliver our BS program in Computer and Information Technology (CIT) to three sites in Purdue Polytechnic statewide locations. In this paper we would like to take a look at where we have come in the last eleven years. We also would like to compare the methods of instruction: face-to-face, hybrid, and online, is one method more successful than others, how do students feel about the methods of instruction? We know the students are unique and those different types of course delivery may appeal to different people. With that in mind, we will look into the students who prefer which environment and why. Finally, if you are teaching a hybrid or online class what can be done in the classroom to be successful.

Introduction

At Purdue Polytechnic Columbus we use a variety of delivery methods for our classes. In the past eleven years we have gone from offering all of our classes in a face-to-face delivery to offering face-to-face, hybrid and online. In the most recent semester, one half of our class offerings were either hybrid or online. In this paper we will discuss why we have increased the use of hybrid and online classes. We will compare the methods of instruction: face-to-face, hybrid, and online, to determine if one method is more successful than others. We will compare student preferences about the different methods of instruction. We know the students are unique and those different types of course delivery may appeal to different people. With that in mind, we will look into the students who prefer which environment and why.

Hybrid and Online Defined

First let us explain what we mean by hybrid and online classes. We will use a definition from the University of Wisconsin Milwaukee for a hybrid class that states that in hybrid classes much of the course learning is moved online which in turn makes it possible to reduce the time spent in the classroom (Swanson and Casner, 2008). Another popular term for a hybrid course is a blended course or mixed-mode course. At Purdue we have offered several variations of hybrid delivery. We have, in the past had students complete labs at home and come in for lectures and in class exercises. The most popular type we use today is to have lectures recorded and available for students to listen to before a scheduled meeting and in the class meeting have in-class exercises based on lecture along with lab activities (for lab classes). This is popularly termed a flipped classroom today. In this situation we completely eliminate the face-to-face scheduled lecture. In other cases we may meet every few weeks as a group for class activities and meet individually either live or virtually in between.

In an online class, the face-to-face component is eliminated or is virtually eliminated (some institutions have varying definitions for online classes where face-to-face time is only used with testing for example) and in a hybrid class, the face-to-face component is merely reduced and still a significant part of the learning environment. With online courses they may be offered either synchronous or asynchronous. Synchronous learning is when classes have a set schedule and time frame, students and instructors are online at the same time in order to participate in the class. Asynchronous classes let students complete their work on their own time. Students are given a time frame, usually a one-week window during which they need to connect to the class and listen to lectures, take exams and quizzes and complete assignments. For our online classes at Purdue we have used the asynchronous method and in some cases added synchronous office hours using WebEx (a conferencing tool used by Purdue University).

Hybrid and Online Benefits

There are many potential benefits of online and hybrid courses including, but not limited to, reach new markets, less time for students to commute, students can complete degrees sooner, ability to accommodate additional students without need for increasing number of classrooms, various ways to interact and to engage students and increase student learning. All of these are benefits but probably the biggest potential benefit is the ability to offer our BS degree in Computer and Information Technology (CIT) at three sites with a smaller number of faculty and less use of adjunct faculty. The number of students in CIT has fluctuated in the last 20 years at the statewide sites but generally, the trend has been for less students enrolled in our program. There are a number of potential reasons including increased competition, moving away from offering an AS degree, more emphasis in recruiting traditional students, our main campus in West Lafayette increasing its' capacity just to name a few. With the decrease in students, we have had a decrease in the number of full-time faculty at our statewide sites. As an example, in the early 2000s, we had four full time faculty in Columbus, now we have two full time faculty to offer our program in Columbus. During this same time period Anderson has gone from two to one full time faculty member. The use of hybrid and especially online has allowed us to offer the BS program without relying strictly on adjuncts.

The Research

As hybrid and online classes have begun to gain popularity over the years, more and more people have begun to do research on which method of instruction receives the best results and the highest satisfaction from both teachers and students alike. Results are particularly important for institutions who wish to know whether implementing more or less online and hybrid classes would be a benefit to them, both in the rate of satisfaction of students but also in their performance scores to ensure that they are performing as well as they should be. Unsurprisingly, the answer as to which method of delivery is a lot more complicated than a simple one model is obviously better.

Soffer and Nachmias (2017) found that online courses had higher satisfaction rates and higher performance rates than their face-to-face equivalent. This is good support that online classes are just as good, if not better than face-to-face classes. However, Jokhan, Chand and Nusair (2018) found that face-to-face students had a better performance than their online counterparts, which is in direct contradiction of the previously mentioned study. These two extremes aren't the only type of data being found either, Nemetz, Eager and Limpaphayom (2017) found no difference in face-to-face results and satisfaction compared to those in an online course. Grandzol (2004) found no difference in teaching quality in hybrid and face-to-face classes, Friday et al. found no differences between face-to-face and online students' performance scores, Priluck (2004) and Oblender (2002) both found no difference in performance between face-to-face and hybrid classes. Because of so much research either finding contradictory data or completely neutral data, it can only be assumed that there are more factors at play here than purely course delivery method. These possible factors will be discussed later.

Hybrid and Online History in Columbus

At Purdue Polytechnic in Columbus we started using hybrid courses around eleven years ago. At that time we had a popular service course CIT 107 that introduced the basics of computer technology and Microsoft Office to Purdue and IUPUC students (our partner university that offer our non-CIT courses for our students). Based on course evaluations and surveys of students and faculty these classes were a success. Over the next several years we decided to offer several of our CIT courses in a hybrid format including CNIT 489 Advanced Topics in Database Technology, CNIT 487 Database Administration, CNIT 392 Enterprise Data Management and CNIT 372 Database Programming. The format we chose was different for each class to accommodate the individual goals and needs of the class. One issue that hybrid did not solve was an increasing push by Purdue and our statewide program to offer more online classes that would allow faculty at statewide facilities to teach in specialty areas with a larger pool of students (all 3 statewide sites and in some cases students from the main campus in West Lafayette) to draw. (Swanson, 2011)

Around 2013-2014 school year the faculty were asked to look at classes that could be potentially be put online. As a group the statewide faculty informally agreed to avoid putting classes early in the curriculum online or hybrid (freshman courses and most sophomore courses) and focus on junior and senior level classes. Several reasons for this that came up at the time of the discussions. First, retention was a factor, in freshman and sophomore year we wanted the students on campus to get more involved on campus and build relationships with faculty and staff. Another reason is we felt that it would be easier for upper-level students to have the discipline to succeed in hybrid and online classes. Finally, by offering upper level classes online, faculty could more easily specialize in their areas of expertise.

It should also be noted that our partner in Columbus, IUPUC has over the same time increased the use of online and hybrid offerings. This is in a variety of subjects and for freshman to senior level classes. Our Purdue students can take many of their non-CIT classes from IUPUC so most students are exposed to online and hybrid format not only in Purdue's curriculum but also in the IUPUC curriculum. In fact, in the course listing for the fall 2019 there are well over a hundred course offerings that are listed.

Face-to-face, Hybrid. And Online Preferences at Purdue Polytechnic

Since our first offering of hybrid classes in 2008 we have been surveying the students taking the classes about their preferences for the CIT courses that they are enrolled in. The format of the survey has changed slightly over each iteration but we have been able to gain a good comparison and glean meaningful information from the results. The original class we converted was CIT 107 as mentioned previously; this class is an introductory service course that we offered for non-CIT majors from Purdue and IUPUC. The class was mainly freshman and sophomore students and the majority of the students were Business majors. As we moved to the survey from 2011, it included the CIT 107 course that at that point we were offering in the traditional face-to-face and hybrid format. We also offered several upper level CIT courses in a hybrid format. At this time IUPUC started offering more of the hybrid and online classes as well so students were seeing the hybrid and online classes on a more regular basis. The 2018 survey included only CIT majors taking courses that were offered either online or hybrid and the students included sophomores, juniors and seniors with a majority of the students upperclassmen.

Here are some of our interesting findings over the years. One thing to note is in the data from 2008 and 2011 the students were all from the Columbus campus. In the last survey the online classes included students from Columbus, Kokomo and Anderson campuses.

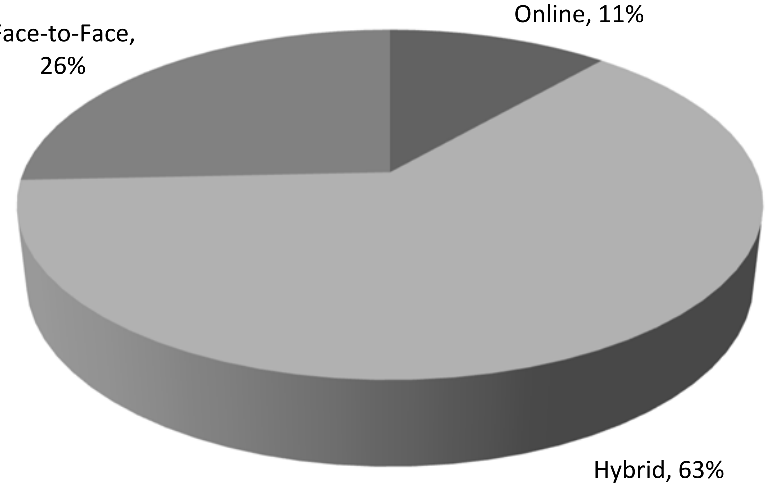

Table 1

Looking at the first survey in Table 1 which consisted of 35 students surveyed, the students had a strong preference for hybrid courses. This data includes students in CIT 107 hybrid version and CIT 107 in the traditional face-to-face version. When broken down by individual classes the students enrolled in the hybrid section favored it by an even larger margin with 86% of the students preferring a hybrid format compared to 48% in the face-to-face class. Students in the hybrid class listed Blackboard, email, online gradebook and discussion forums as the most useful tools in the hybrid class.

In the survey three years later in 2011 in Table 2 which consisted of 38 students, there is still a strong preference for hybrid, traditional face-to-face preference dropped slightly and online preference increased slightly. The 2011 survey included upper level CIT courses taught in hybrid format, and again the CIT 107 with one section taught as hybrid and another section that was delivered face-to-face format. Delving into the data in more depth the students in the face-to-face class preferred the hybrid format more than the students enrolled in the hybrid section (82% to 58%) and the CIT 107 non-majors preferred the hybrid class more than CIT majors in upper level classes (70% to 57%). The favorite tools listed by the students in the hybrid class were Blackboard, PowerPoint slides and email. Hybrid students main reason for choosing the class was because it best fits their schedule and they preferred it over online and traditional and it meant less driving with only meeting one day a week.

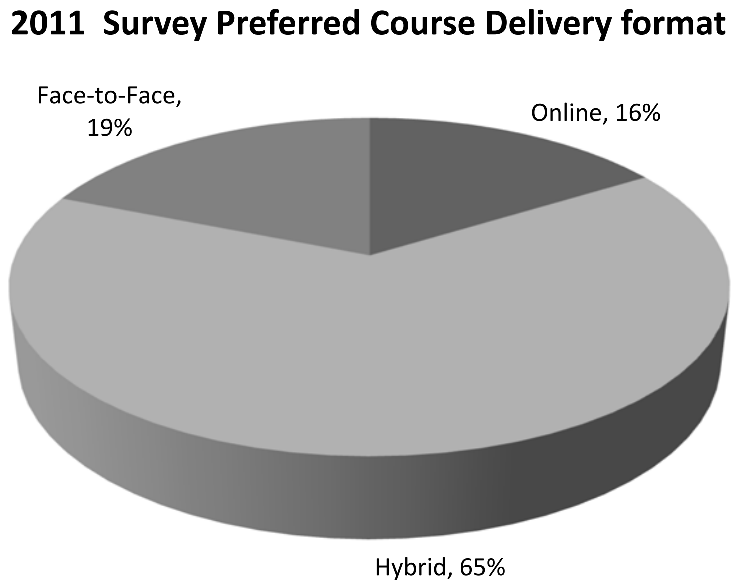

Table 2

The most recent survey in 2018 consisting of 25 students included only CIT majors in 200, 300 and 400 level online and hybrid classes. By the time of this survey we no longer offered the CIT 107 class at the Columbus campus. In the latest survey the online preference stayed about the same compared to 2011 however, the preference for hybrid format dropped with increased preference of the traditional face-to-face format. One possible reason is this is the first survey where online CIT classes with labs was included which may indicate a higher preference for face-to-face in lab classes. Students in the classes found pdf of lectures, online discussions and weekly announcements as the more useful tools in the online and hybrid classes.

Over all of these surveys we have looked at the data from different points such as junior/senior CIT majors vs. freshman/sophomore non-majors, students enrolled in the different formats: face-to-face, hybrid and online and we don't have any clear cut conclusions. Over this ten year period, the hybrid course has been the favorite although the percentage dropped in the last survey. A possible reason is that the hybrid has the components of the face-to-face and online and appeals to fans of both. Another survey we conducted on students in 2016 and 2017 where we have students rank the three formats consistently had hybrid as the second choice in over 90% of the student surveys. Again if students preferred online the hybrid had online components and if the student liked the face-to-face hybrid with many face-to-face components was a good second choice.

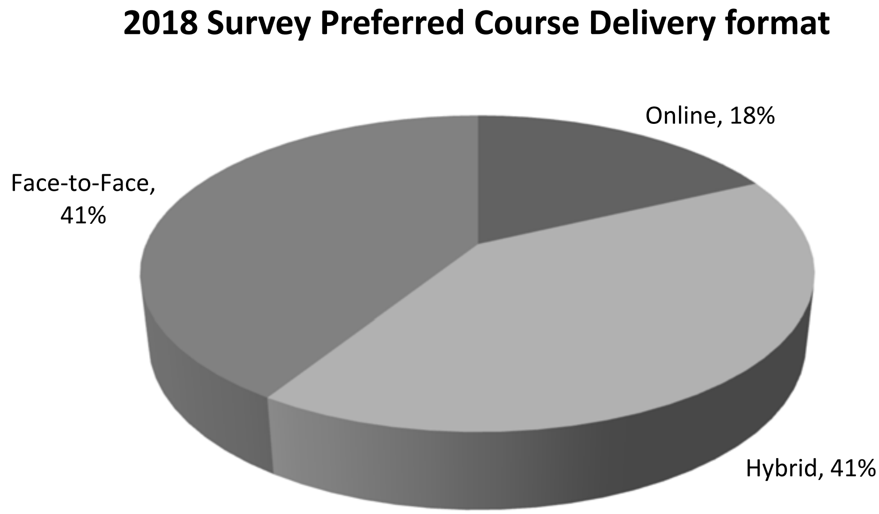

Table 3

Performance and Satisfaction

As we discussed earlier, there are many instances of equal performance scores and satisfaction rates between face-to-face, hybrid and online courses. Those studies that found difference in a student's preference or ability within a class were found supporting both ends of the spectrum as well, meaning that there isn't a lot of consistent data backing up any one model. The research has shown that there is a high level of variability when it comes to the success of the different classes. So as a future teacher or student, what are the factors that lead to a successful course, regardless of class type?

Starting with the student, it has been found that students with a higher GPA are more likely to have a higher performance score, regardless of the method of instruction (Burns, Duncan, Sweeney, North and Ellegood, 2013). Another study also found equally good performance scores among the students in both course types, where researchers speculated the GPA requirement to take the course may have had some effect on the overall success (Nemetz, Eager and Limpaphayom, 2017). Although one can't control their students GPA's, it is important to acknowledge that the past predicts future and that this may be something that could affect a course regardless of the model being used. Another important thing is the students' investment in the course. One study found that students who were more invested in the face-to-face setting did much better versus the less interested online students (Jokhan, Chand and Nusair, 2018). Although teachers can't force a student to put in more effort if they are unwilling, creating activities and assignments that encourage your students to become invested in the topic may be a good place to start.

There are certain things that teachers can do to hopefully make their face-to-face, hybrid or online course more effective. As previously mentioned, providing assignments that make the students become more invested in the information can be an important step. However, one of the biggest things a teacher can do to help improve the success and satisfaction rate, is to match the course model with the specific class. Each model has their strengths and weaknesses when it comes to instruction method, which makes certain models more effective with different types of classes (Estelami, 2012).

Classes that require more immediate feedback or in depth directions or analysis will probably be better off with a face-to-face class. Online classes are better for classes that require less direction and more personal reflection or memorization. Since the hybrid is a combination between the two, it shares both strengths and weaknesses from both course models and thus is good for a mixture of those class types.

The overall point here is that there is no right way to organize and plan a class. Knowing this information and using it accordingly can be helpful, but overall with the variety of students and topics, each model has a good chance of success or a good chance of mediocrity. As such, each professor knows their material and students better than we do, and encourage everyone to do what they see fit for their specific courses.

Discussion of Implementation

Although we previously mentioned that we are not in any position to tell professors what kind of model they should be using for their classes, we do recognize that the process of deciding a method of instruction can be difficult and confusing. Because of this we will be using examples of classes currently being taught at Purdue Polytechnic in all three formats and why they were chosen and work well in their given format.

The first class is CNIT 272, Database Fundamentals, which is taught in the face-to-face model. This course works well in this format because it revolves around many in class exercises assigned as individual and group assignments. These exercises lead to class discussion and are given immediate feedback from the professor. There is also a large team project that requires collaboration through multiple students across two separate classes (CNIT 255, Introduction to Object Programming). Students are given in class time to work together and receive instruction and feedback from the professor. Students also are required to complete labs using the SQL programming language. The fact that this class depends on team work, discussions and immediate feedback from the professor means that it is a great example of a face-to-face class.

The next course is CNIT 280, Systems Analysis and Design Methods, which is taught as a hybrid. This class works really well because it utilizes the strengths of both the online and face-to-face course. The class meetings during the week are used to facilitate discussions and group work as they are set to analyze and solve problems and receive feedback from the professor as they have their discussions. The online portion is typically used to listen to lectures, do assignments and quizzes regarding lecture and reading assignments, all at the students' own pace. The assignments and lectures in the online portion work well because that information can be easily done in an online setting and does not take away any of the class time needed to go towards more detailed topics in class. This class is a great example of the two competing components that can work well together to create a hybrid. Also, Purdue Polytechnic at the statewide locations have a large number of commuter students, which means that hybrid classes are used to cut down on the amount of time traveling a student needs to do for classes.

Finally, we will be looking at CNIT 487, Database Administration, an online class. This class works well in the purely online format because it requires a lot of memorization and online assignments on the part of the students. Their assignments also use tutorials to walk them through certain concepts and enhance their learning process. The professor also posts videos, lectures and demos to help aid the student in their studies which is extremely helpful. While assignments have due dates, the students are allowed to work ahead at the pace that works best for them. This class works well in the online model because it does not require much discussion, immediate feedback, or working in groups and more often emphasis is placed on the memorization and online assignments and videos. It is important to note that Purdue Polytechnic has 3 statewide locations offering the CIT program in Indiana, online classes allow professors to focus more in their areas of expertise.

This is not a definitive answer as to whether or not you should choose a certain model for a certain type of class, however this could be used as a guideline for those instructors who are unsure as to which model their specific course would work best as. The factors mentioned in previous sections are also important to take into consideration, but these class assignments and goals of the course mentioned work well with the chosen format they are currently in. But as stated before, professors know their materials and students better than we do and should use their own discretion when making these decisions.

Conclusions

Looking at the research and our surveys there does not appear to be a silver bullet for the best way to deliver classes or for that matter which classes are the most popular with the students. The research done by others was not consistent in results and tends to prove what we have believed all along, it is highly variable. The best method will change from class to class, student to student. In our surveys the hybrid course has scored consistently well over the last ten years in the surveys and in head to head comparisons. Again, as stated it could be related to the fact that it has major components of the face-to-face and online classes. With the in-class portion of a hybrid class the students can get the immediate feedback and the opportunity for in depth directions or analysis that was mentioned as a strength of the face-to-face class. The online component of a hybrid can be developed to have more personal reflection, less direction, cover more memorization, all advantages of the online class according to the research. With the addition of more lab classes being converted to online and hybrid format there appears to be a trend of increased popularity with the traditional face-to-face classes in the latest survey. We speculate this could be the result students want the immediate feedback in the typical programming labs and have additional opportunities in the face-to-face format. Although this paper was not focused on particular tools used in the classroom, our surveys indicate items that provide timely feedback such as labs, discussions and non-graded assignments that have feedback were very popular with students along with items that disseminated information such as weekly announcements, instructional videos and lecture pdfs. These tools have changed over the last 10 years. We plan to continue to add and tweak the tools we incorporate into the hybrid and online classes to meet the needs of each student. Just like the tools used we plan to keep learning and keep moving forward, honing in on what is most successful and improving each course delivery method.

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Round Table Panel Discussion: LMS Plugins and Integrations

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Abstract:

This session provides an opportunity to discuss and hear about how other institutions are handling LMS Plugins and Integrations. This includes administration, deployment, licensing, suggestions and perhaps unpredictable complications

Presenter Bio:

Anthony Basham is the Projects Coordinator/Moodle Coordinator at Berea College. Anthony has many years' experience working with faculty using cutting edge educational technology with teaching and learning in the emerging and evolving classroom environment.

Enhance the Learning Process and the Quality of the Students Work in Online Courses Using multiple High Impact Practices (HIPs) and CIVIC Strategies

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Abstract:

This session will focus on my recent experience of teaching fully online courses in the Master of Science in Health Informatics program at Mercer University. I have exclusively taught all of my classes, at Mercer, in an online mood using WebEx and Zoom software to conduct weekly virtual meetings for two hours per class. During the session, I will share my experiences with the incorporation of weekly virtual meetings and the use of High Impact Practices (HIPs) and some CIVIC strategies to improve the quality of student work, specifically in their writing skills for a capstone project. I will demonstrate the online capstone course, and present evidence that I collected from students on the methodologies used in other online courses to support the teaching and learning process.

Presenter Bio:

I hold MBBCh, MPH, PhD in Health Informatics from University of Missouri Informatics Institute (MUII). I am an assistant professor at the Mathematics, Science, and Informatics department in Penfield College at Mercer University (Atlanta-Campus).

Promoting Transformative Active Learning Environments

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Abstract:

Recently, Campbell University has been committed to improving teaching and learning on campus and online through active learning. Three university initiatives have been the focus behind using active learning strategies. Several educational theories encourage active learning engagement for adult learners. For example, transformative learning theory will be discussed as it relates to active learning. An explanation of how transformative learning aligns theory to practice will be provided. The practice of active learning will be described by providing examples of active learning techniques that can include technology. Technology integration is not required for all active learning strategies. This presentation will address a spectrum of strategies ranging from “no tech” to technology infused active learning techniques. Session participants will have the opportunity to engage in active learning strategies such as think-pair-share (no tech). Another active learning strategy will be shared with session participants called ClassFlow. ClassFlow is a free web based active learning tool. ClassFlow allows instructors or trainers to use the quick poll, create an activity, use a whiteboard, and create a lesson or assessment.

Presenters Bios:

Dr. Charlotte Russell Cox is the Instructional Technology Specialist at Campbell University. She holds a BS degree in Education from UNC-Greensboro and a MS in Instructional Technology from North Carolina A&T State University. Charlotte recently completed a doctoral degree from NC State University.

Allan Winter is the Academic Computing Coordinator and Adjunct Professor of Applied Music (French Horn) at Campbell University. His experience includes instruction in secondary and higher education. His bachelor’s degree in Education is from East Carolina University. Allan holds a Master of Science Degree in Education with an emphasis in Music and Computer Assisted Instruction from the University of Illinois at Urbana-Champaign, where he was a graduate assistant at the Computerized Education Research Laboratory.

Does your school have or need a mobile app?

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Abstract:

A large percentage of Internet traffic anymore now originates from mobile devices such as smart phones. Does your school have a custom branded mobile app? Do you think you need one? What purpose does it serve? What goals does it or would it achieve? Would it be used internally only for existing faculty/staff/students or could it also be a recruitment tool or communications tool for reaching others? Let's share experiences, questions, ideas, concerns, options, etc. This will be a round-table discussion to collaborate together on this topic.

Presenter's Bio

Blair has served at Cairn University since 1994 in the Technology Services (IT) department serving a variety of different roles over the years including web development and support, helpdesk, network administration, and more. He has served several terms on the ASCUE board as well.

Get Inspired by the New D2L!

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Abstract:

Welcome to the NEW D2L. It’s time you took another look. We are the makers of Brightspace – the learning platform built for people that care deeply about student success. Join us for a live demonstration of the new Brightspace learning platform followed by a discussion with the special guest Keith Fowlkes, Vice President, Technology Category, E&I Cooperative Services where we discuss how and why E&I selected Brightspace as their exclusive LMS partnership, plus we will discuss the incredible offer.

Presenter Bio:

Willem Boom has over 24 years of experience in the technology and EdTech space. He has a well rounded background in eLearning Content as well as platforms. He currently serves as D2L’s Senior Director, Worldwide Channel Sales and is based in Bend, Oregon.

Laying the Groundwork to Create a Quality Online Associates of Arts Degree Program

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Abstract

Institutions offering online courses have made it more accessible for students to pursue an education. According to research conducted by the Babson Survey Research Group (https://www.onlinelearning-survey.com/highered.html), student enrollments in online education continue to rise. While some institutions are prepared for the increase in enrollment, others may face difficulties when designing a learning experience that contains a high level of quality and diversity. Many students enter higher education with their own expectations of how the learning process should take place. These expectations can determine how students interact with their educational environment. Students should be able to focus more on learning and mastering the content than navigating the course. Courses should be designed from the student's perspective, be engaging, and easily accessible. Well-designed courses promote learner to learner, learner to content, and learner to instructor interaction. In this session, learn how one institution is striving to improve overall online course quality.

Presenter's Bio:

Dr. DeLee is the Director of E-learning Design and Quality Matters Coordinator at Catawba Valley Community College. She has worked in higher education for over 18 years and holds a Ph.D. in Computer Technology in Education along with several Quality Matters Certifications.

Developing Creative Organizational Associations & Partnerships

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Abstract

In today's difficult economic environment in education, it is crucial to create new partnerships with like-minded, innovative organizations and institutions for many reasons. This interactive session will explore several new approaches to organizational partnerships and discuss ways educational institutions and other non-profit organizations can work together to innovate, communicate and find efficiencies in technology operations and research focus areas. This interactive session will give specific examples of a number of organizations and institutions that have found significant benefits in creating new, innovative groups to solve challenges in organizations and technology development. Many of these new innovative groups have also found benefits in research and information gathering, cost savings and cooperative operations. This session will focus on projects between private and public higher education institutions and non-profit organizations such as E&I Cooperative Services, Internet2 and the Higher Education Systems and Services Consortium (HESS) as well as other public/private partnerships.

Presenter's Bio:

Keith Fowlkes is a veteran technology leader serving as CIO for Saint Mary's College, University of Virginia- Wise and Centre College. He is currently Vice President for E&I Cooperative Services' Technology Group and is also co-founder and Vice President of the Board of The HESS Consortium.

Using Simulated Learning Environments in Teacher Preparation Programs

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Abstract

The presenter will:

Review literature on computer simulations in teacher education and discuss the advantages and disadvantages of computer simulation in education.

Discuss incorporation of simulation in a teacher education program for initial licensure candidates.

Share student reactions and reflections to using computer simulation. The presentation will begin with a brief literature review of the use of computer simulation in teacher education programs.

This information will be summarized around the advantages and disadvantages as well as what we know and the remaining questions for exploration.

Finally, a pilot study in which computer simulation software was used with 50 initial licensure teacher candidates in both an introductory to special education course and a behavior management course will be shared. Candidates reflected on their experiences with using computer simulation. The instructor of the course will also share lessons learned.

Presenter's Bio:

Roberta Gentry is an Assistant Professor at Virginia State University. She teaches graduate and undergraduate courses in special education.

Electronic Mentoring: Support for Beginning Teachers

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Abstract

Electronic mentoring, defined as "a relationship between a more experienced individual and a less skilled or experienced individual primarily using computer mediated communication is intended to develop and improve each mentee's skills, confidence, and cultural understanding" (Jaffe, Moir, Swanson, & Wheeler, 2006). While this concept is fairly new to education, it has been implemented in the business world for numerous years with positive results (Ensher, Heun, Blanchard, 2003; Single & Mueller, 2001; Single, & Single, 2005). Electronic mentoring offers advantages including flexibility whereby mentors and mentees can connect when needed, regardless of geographical location and time constraints, in a format that mimics and expands traditional face to face interaction and in a way that increases solutions while simultaneously reducing costs of implementation and access (Smith & Israel, 2010). Additionally, trained mentors can be drawn from a much larger pool of seasoned teachers than that typically available in local schools. This session will present findings from a qualitative study utilizing transcripts of conversations occurring between novice special educators and their mentors in an electronic mentoring site.

Presenter's Bio:

Roberta Gentry, Ph.D. spent twenty years in the public-school setting as a special education teacher and administrator prior to a career in higher education. Currently, Dr. Gentry is an Assistant Professor at Virginia State University preparing undergraduate and graduate education majors.

Teaching Effective Digital Research Skills: What May Be Missing

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Abstract

"Digital Technology," one of the key competencies identified by the NACE required to prepare college graduates for career readiness, is defined as the ability to: "Leverage existing technologies ethically and efficiently to solve problems, complete tasks, and accomplish goals. The individual demonstrates effective adaptability to new and emerging technologies." For well over a decade, incorporating digital technologies into course curricula has been widely embraced by learning institutions to enhance student learning and increase digital literacy skills. However, when teaching digital research skills, "adaptability to new and emerging technologies," requires more than the ability to become quickly proficient in the latest software; it also requires an understanding and awareness of how the Internet-based information resources consumed are organized and monetized. This presentation offers a pedagogical approach to teaching the more common Internet-based sources of information used by undergraduates outside of the classroom setting—Wikipedia, Google, and social media—by incorporating ethical questions raised in the past on the transparency, veracity, and accountability embedded in the research students have become dependent on.

Presenter's Bio:

Nancy Gilbert has taught First Year Composition and Literature at Georgia State/Perimeter College for 15 years. Her academic interests include Social Linguistics, Media Communications, and Early 20th Century British and Irish Literature.

Engaging your students with the Active Learning Platform

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Abstract

This session will focus on the distractions Instructors compete with everyday inside the classroom. It will highlight Echo360's active learning platform and walk through ways the platform help keep your students engaged. If you have an interest in capturing your lecture, polling or creating a collaborative discussion this session is for you!

Presenter's Bio:

Jason Gildner, Customer Success Manager, Echo360 Jason has spent the last 15+ years working in higher education before joining the Echo360 team. Jason's experience with enterprise software solutions and his instructional design background allows him to service over 40 Higher Ed customers

Break Out! Using Escape Room Strategies to Teach Content to College Students

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Abstract:

Want to increase critical thinking and problem-solving skills in your college students? This session will demonstrate how course content, critical thinking and problem-solving intersect in a simulated escape room. There will be a demonstration and discussion related to using tools in an active learning classroom as well as how to incorporate digital technology into the activity, such as QR codes, tiny urls, etc. Come learn strategies for developing an escape room and try to break out before time is up!

Presenter Bio:

Holly Gould began her teaching career in 1990 and became a full-time professor in 2002. Her interests include including teacher preparation, differentiation/responsive teaching, multicultural education, curriculum and instruction, education of gifted students, and instructional technology

Ensuring Regular and Substantive Instructor Interaction in Online Courses

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Abstract

Regular and substantive interaction is a key federal and accreditation requirement for online courses and programs. In this session we will outline mechanisms and processes we developed for the online faculty at our institution. We will start with the course development process and then focus on what it takes to deliver a quality online course while ensuring accreditation requirements are met.

Presenter's Bio

Sali has been serving as Director of Educational Technology and Distance Learning at Cairn University since February 2012. Prior to this position, he served as Manager of Academic Computing for 14 years for the University. He has been attending ASCUE for more than 20 years.

An introduction to Sentiment Analysis

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Abstract

Sentiment analysis is the automated process of understanding an opinion (pro, con, neutral) about a given topic from written or spoken language. By using sentiment analysis, companies (universities?) can gain key insights about their products and services and utilize these insights to leverage improved decision making.

With enormous amounts of data generated each and every day, sentiment analysis has become very important. However, dealing with large amounts of data quickly and accurately using humans is nearly impossible. Fortunately, automated analytical software is quickly becoming available for accomplishing rapid and accurate sentiment analysis.

This presentation will provide an overview of what sentiment analysis is, the different approaches, and the caveats and limitations of what is possible. The presentation will also include a demonstration of a very inexpensive and accurate software product to perform automated sentiment analysis.

Presenter's Bio

Dr. Steve Knode is a retired Air Force officer who served twenty years in the USAF in a variety of analytical and decision making positions. He is a professor at the University of Maryland University College (UMUC) where he develops and teaches graduate courses in analytics and decision making.

Implementing ADA Compliant Design in Your Online Course

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Abstract

Designing online courses that meet ADA compliance requirements can prove challenging. However, it is imperative that educators demonstrate due diligence to develop ADA compliant online instructional opportunities within their courses (Rabidoux & Rottman, 2017). Adapting course materials, such as documents, hyperlinks, images and graphics, and videos, is an excellent way to enhance student learning online while complying with ADA requirements. This presentation is designed to (1) assess the current state of compliance in your course, (2) address the current limitations students with disabilities face when completing online courses work, and (3) outline strategies for educators to design online courses accessible to all students, includes those with disabilities. Furthermore, this presentation will demonstrate how these best practices can be employed in a nursing program to ensure ADA compliance with online courses.

References:

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Presenter's Bio:

Nicole P. Lipscomb-King, MSIT, MSTS, is the Instructional Designer for Georgia Baptist College of Nursing of Mercer University in Atlanta, Georgia. She provides personalized, curriculum design support to graduate and undergraduate nursing faculty, and facilitates the college Learning Management Systems

Workstations to High Performance Computing… and everything in-between!

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Abstract:

We're facing an explosion of data to be processed and applications are requiring more and more hardware resources. As a result, we're seeing an increasing need for computer power which will perform above-and-beyond your typical run-of-the-mill desktop.

At Washington and Lee University, we're working on developing a process to help match appropriate resources with the needs of our staff and faculty. First, we evaluate the desired workflow to determine what resources are necessary and how frequently they'd be used. Then, we help them find the best hardware solution. Perhaps it's a secondary machine. Maybe their primary machine needs to be a workstation-class desktop with a souped-up graphics card. Or, they might need occasional bursts of truly High Performance Computing purchased through AWS (Amazon Web Services). If they use AWS, we'll help configure the EC2 instance and train them on usage.

Come to this session to learn in detail how we use this process to provide our faculty and staff with computing options that would otherwise be unavailable to them with our standard configuration computers.

Presenters' Bios:

Tom is the Senior Technology Integration Specialist - STEM at Washington and Lee University. He supports a variety of technology needs for faculty and staff in the sciences. In addition, he supports the entire campus on High Performing Computing needs through AWS (Amazon Web Services).

Roundtable Discussion: ePortfolios

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Abstract:

Bransford, Brown, and Cocking (2000; 18, 21) call metacognition "an internal conversation" in which students monitor their own understanding and state that teachers should explicitly emphasize metacognition because it "can enhance student achievement and develop in students the ability to learn independently."

Development of an academic ePortfolio provides students the opportunity for metacognition and reflection, and it serves as a process to collect evidence of their KSA (knowledge, skills and abilities), which can also be valuable during their career search.

Not only are ePortfolios valuable to students, but they can also serve as a valuable resource to the education institution. Assessing the students' evidence of learning can help to identify skill gaps and the need for curriculum changes and improvements.

The purpose of this roundtable discussion is to discuss and share:

1. How has ePortfolios benefited your students?
2. How has ePortfolios benefited your program? Institution?
3. What tool is used for the ePortfolios? - what factors were considered to select this tool - what has the experience been with the selected tool?
4. What are future plans for ePortfolios?

Presenter's Bio:

Carmen has served as a faculty member, faculty mentor, online-learning mentor, Quality Matters Peer Reviewer, and Program Director. She is passionate about education, helping others, and modeling a growth mindset. Carmen's favorite students are her four children and favorite teacher is her husband.

Making Campus Life Accessible to Online Students through Technology, Innovation, and Pedagogy: The TIP Method for Online Student Engagement

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Abstract:

While the majority of enrollments in online programs are still post-traditional students seeking the convenience and flexibility of an online degree, campuses are beginning to see traditional students enroll in online degrees in order to reduce college costs, particularly room and board. Both populations of students are seeking a fuller college experience beyond the usual links to campus resources and services provided to students at a distance. In order to provide a holistic campus experience and to aid in enrollment growth, institutions are seeking innovative ways to address the changing needs of online students. The State University System at Canton (SUNY Canton) created a model for engaging online students in campus life, call the TIP method. This model, grounded in technology, innovation, and pedagogy, maps to the different dimensions of campus life: academic, social, and co-curricular. The TIP method for online student engagement uses technology to provide career services, study abroad opportunities, academic advising, student activities, student leadership, new student orientation, and an online varsity eSports team to students at a distance.

Presenter's Bio:

Molly A. Mott, Ph.D., is the Associate Provost and Dean of Academic Support Services and Instructional Technologies at SUNY at Canton. She has overseen the expansion of services for online students and has presented at national and international conferences on instructional technologies.

Escape!-- Breaking Free with Digital Breakout EDUs

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Abstract:

Digital Breakout EDUs turn your course content into online 'escape' games students play while engaging in higher order thinking and real-time problem-solving skills. Created with user-friendly Google Sites and Google Forms, Digital Breakout EDUs transform the classroom into a 'gamified' and collaborative learning environment. These breakout experiences encourage collaboration among students, friendly competition, and promote the growth mindset and grit necessary for their success. In this session, we will play a few different Digital Breakout EDU games and then work with each other to adapt our own course material into a Digital Breakout EDU.

Presenter's Bio:

Angela Pilson is an avid edtechie with a passion for making educators' lives easier and less stressful. She hails from Charleston, SC, where she teaches composition and literature courses to secondary and post-secondary students.

Maximizing the Functionality of Online Platforms: Examples from a Nationally Accredited University School of Education

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Abstract:

Fairmont State University's School of Education (FSU SOE) has earned national accreditation status since 1954. The SOE embeds technology in its educator preparation by providing a variety of authentic experiences with online platforms. FSU provides accounts to the Blackboard (Bb) Learning Management System and the cloud-based assessment management platform, TaskStream. Faculty, teacher candidates, public school teachers, and public school students utilize these online platforms for various purposes. This presentation will highlight the utilization of Bb online learning tools in courses as well as how the institution uses the Bb "Sandbox Feature." Additionally, presenters will demonstrate the functionality of TaskStream's Accountability Management System (AMS) and the Learning Achievement Tools (LAT). The AMS comprises course and program spaces that permit documentation of the FSU and SOE assessment cycle processes. The LAT allows for the design and implementation of course and clinical assessments and the submission of assignments, portfolios, projects, artifacts, etc. Attendees will find the variety of information and initiatives shared in this session to be practical, worthwhile, and applicable for future implementation.

Presenters' Bios:

Dr. Budd Sapp is a Professor in Fairmont State University's (FSU) School of Education (SOE) where he teaches online professional education courses at the graduate level and is a Liaison to several county public schools in the FSU SOE Professional Development School Partnership.

Erica Garrett is TaskStream Coordinator and Adjunct Faculty at Fairmont State University.

Revisiting Going Textless: One Department's Aim to Tackle the Soaring Costs of Textbooks

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Abstract:

This presentation will reflect and report on the successes and challenges of going textless the last two years in select general education core courses at Ohio Christian University. I will also share the changing awareness of and opinions about OER options and report on the growing accessibility of OERs.

Presenter's Bio:

Dr. Krista Stonerock is an English professor at Ohio Christian University, where she also chairs the General Education department. She resides in Circleville, Ohio, with her husband, Travis, her two daughters, Maia and Sophie, and her rescue doberman pinscher, Gunther.

Review of Educause 2019 Top 10 IT Issues

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Abstract:

A Roundtable discussion highlighting and expanding on the Educause 2019 Top 10 IT Issues.

1. Information Security Strategy, 2. Student Success, 3. Privacy, 4. Student-Centered Institution, 5. Digital Integrations, 6. Data-Enabled Institution, 7. Sustainable Funding, 8. Data Management, Governance, 9. Integrative CIO, 10. Higher Education Affordability.

A discussion on how your institutions are looking at and addressing these Top 10 Issues. Are they on your radar? What steps are you taking with regards to these topics?

Presenter's Bio:

Dr. Tina Stuchell, Executive Director & CIO at University of Mount Union. Tina is in her 29th year at the University of Mount Union, 15th year as CIO. She has a Bachelor of Science degree in Information Systems, Masters of Arts degree in Management, and Ph.D. in Information Systems.

Maintaining Civility in Online Debates in an Era of Incivility

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Abstract:

This session will focus on ways to integrate online learning tools into face to face classroom courses with students who may be resistant or anxious regarding online learning and technology. Research findings from classroom activities over the past two years will be presented highlighting ways technology has been incorporated and student feedback from the experiences. Recommendations based on these findings will also be presented with the hopes of engaging the audience in a "how might you" conversation about potential applications they could consider for their future traditional face to face classroom courses.

Presenters Bios:

Dr. Lynn Tankersley is an Associate Professor of Criminal Justice in the Department of Leadership Studies in Penfield College of Mercer University. Prior to coming to Mercer, she worked in the field of corrections throughout the State of Texas.

Dr. Stephen Ruegger is Associate Professor of Public Safety Leadership

Increasing Learner Retention Rates in Online Learning Environments

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Abstract

This panel is designed to allow higher-ed faculty to hear from students and professionals in the field of online learning regarding ways to improve the teaching and learning experience online. Panel members will consist of students from all levels of online education: undergraduate, master's, post-master's, and doctoral programs. Online learning professionals on the panel will give their insight from both sides of the spectrum. An emphasis will be placed on student retention in online learning environments.

Presenters' Bios:

Matthew is an Instructional Designer & Technologist with the Center for Teaching Excellence to Advance Learning (CeTEAL) at Coastal Carolina University (CCU). He also serves as a nationally certified Quality Matters (QM) Master Reviewer and Peer Reviewer for Online & Hybrid Courses.

Jessica is an instructional technology specialist with the Office of Online Learning. She is also teaching associate in the College of Science. Hall serves as a board member & reviewer for the Multimedia Educational Resource for Learning & Online Teaching as well as the Online Learning Consortium.

Mitigating the Impact of Natural Disasters on Academic Continuity: A Reflection on Hurricane Florence

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Abstract

A vital part of academic continuity is the establishment of a clear contingency plan. Oftentimes, theoretical contingencies are planned mentally but not enacted at the beginning of the semester, thus leaving no time to clearly deploy the plan once the natural disaster nears or occurs. In this session, we will discuss how faculty developers at Coastal Carolina University supported faculty before, during, and after the storm to ensure academic continuity as they dealt with a historic three-week long suspension of academic operations due to the impacts of Hurricane Florence.

When Hurricane Florence's projected landfall was three days out and we saw the computer models showing the projected precipitation and potential category four wind impacts, we were concerned. After Florence passed and officials assessed wind damage and current/projected flood impacts, it became clear that the University would be closed for an extended period. By week three of the suspension of operations on main campus, administration highly encouraged all faculty to put course content online to maintain academic continuity.

Presenters' Bios:

Matthew is an Instructional Designer & Technologist with the Center for Teaching Excellence to Advance Learning (CeTEAL) at Coastal Carolina University (CCU). He also serves as a nationally certified Quality Matters (QM) Master Reviewer and Peer Reviewer for Online & Hybrid Courses.

Co-presenting are CeTEAL team members George H. Warriner III, Jean Bennett, and Tracy Gaskin. George serves as the Instructional Technology Trainer, Jean is the Assistant Director, and Tracy is the Faculty Development Program Coordinator.

You Too Can YouTube: Developing Educational Videos to Enhance Instruction

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Abstract:

YouTube is a popular, online entertainment venue that can also be a very useful instructional tool in college level classes. College instructors utilize self-produced YouTube videos in their face-to-face class meetings or integrate such videos into online instructional platforms. A common practice used by college instructors, is to sit in front of a computer and connected digital camera and record slide show presentations. However, the production of more dynamic, engaging videos, may exceed the technology skills of many college instructors. One solution to this problem, is to team college instructors, who are content experts, with faculty developers who are experts in technologically based-pedagogies. In this session, the presenters share their experiences about a collaborative video project. The project involved the development of a series of science education instructional videos targeting preservice middle level and secondary science teachers. Each presenter will discuss the challenges they faced as well as what they learned through the experience. These challenges involved issues with areas such as script writing, storyboarding, and the post-production process.

Presenter Bio:

George is Instructional Technology Trainer in CeTEAL at Coastal Carolina University in Conway, SC. He advises faculty in course design and technology integration practices to enhance learning. His main research interest is investigating how the application of Virtual Reality improves instruction.

Austin is an associate professor of science education at Coastal Carolina University in Conway, SC. He prepares elementary, middle level and secondary preservice teachers in science pedagogy. His main research interest is helping preservice teachers to develop science mindfulness.

The Cloud First Initiative at Wabash College

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Abstract:

In 2016, Wabash's IT Services adopted a "cloud first" approach to software and services, with a goal of not purchasing any more on-premise servers or storage. Two years into that initiative, in this presentation we will take a look at how the goal came about, what's worked and what hasn't, surprises we encountered, budget implications, and where we plan to go from here.

Presenter's Bio:

Brad Weaver is the Director of Information Technology Services at Wabash College, a position he has held since 2001. He is a long-time ASCUE attendee, and currently serves as the ASCUE treasurer.

Building Continuity Across Classroom AV Platforms

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Abstract:

Building community across classroom AV platforms

Presenter's Bio:

Andrew is a proud 16 year veteran of the United States Army. He attended North Carolina State University and holds a B.S. from the School of Agriculture in Turf Management. He has been in Project Management for over 8 years and lives in Dunn, NC with his wife, Taylor and 4 handsome sons.

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