

## Title:

# Hybrid to online transition due to COVID-19: Case study of instructor effort and student performance

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## Abstract:

### Hybrid to online transition due to COVID-19: Case study of instructor effort and student performance

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**Description:** This study quantifies the impact of a rapid switch from hybrid to online instruction using Zoom® on instructor effort and student performance. Classes were converted over Spring break, although fine tuning continued throughout the semester. Three separate late-starting condensed experimental courses (online, Spring 2020) were compared to the same three courses taught immediately preceding the switch (total 9 as hybrid, Fall 2018 - 2019). All courses used slightly modified Team Based Learning (TBL) format to accommodate a condensed timeline of 7-8 weeks.

**Results:** Statistical analysis using Welch's 2-sample t test ( $p < 0.05$ ) showed that the instructor needed more time to train (online 52.15 vs. hybrid 6.72 hours/Course) through the university system (CELT, <https://www.uky.edu/celt/>), revise slides (online 26.67 vs. hybrid 16.5 hours/Course), revise each syllabus (online 11.0 vs. hybrid 5.13 hours/Course) and counsel students (online 19.0 vs. hybrid 11.94 hours/Course). Deadlines for online assignment submissions were flexible to accommodate possible internet disruptions. When analyzed with Fisher's Exact test ( $p < 0.05$ ), students submitted 9 out of 10 assignments late, mostly on the last day of class. Grading standard and letter grade outcomes were similar for both (2-factor ANOVA,  $p > 0.05$ ). Students with higher attendance, online or in-class, also received higher letter grades (OLS scatter plot,  $p < 0.05$ ). Additionally, even for online classes, students favored TBL instruction, teams, duplicate quizzes, 4S Application Exercise, Zoom discussions and breakout sessions.

**Conclusion:** Experience using slightly modified TBL over 7 years with high student acceptance, and excellent training from CELT for Zoom (<https://zoom.us/>) and Canvas use (<https://www.instructure.com/canvas/>), facilitated a quick transition from hybrid to online teaching. However, this transition required significantly more instructor time and effort. Flexible assignment submission deadlines in Spring 2020 increased grading pressure. Such flexibility was not granted in Fall, 2020, providing a more reasonable timeframe for grading.

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## Introduction and Background:

After the first case of COVID-19 in the state of Kentucky on March 6, 2020 and after WHO announced COVID-19 a public health emergency of international concern, and then a pandemic on March 11, 2020, University of Kentucky mobilized quickly to move teaching through online means and ensure the continuation of education. In the meanwhile, our University has offered late starting short courses to undergraduate students from even before 2012, when the lead author joined the program. These classes start after the semester has begun and allow undergraduate students to drop a course and pick up another elective course, maintain full time status and earn 2 credits for ~30 hours of instructor-student contact. Each natural science course included in this study were offered by the College of Arts and Sciences to 30 undergraduate students in any year of their study. These courses included natural science topics including human physiology, as well as different topics in humanities, such as history, geography, culture and social issues etc. all around the topics of food, beverages and human reproduction. These experimental courses were revised after 3 semesters. Four courses were taught each Fall, but the 4<sup>th</sup> course was excluded from this case study.

### Fall 2018 (Hybrid)

A&S 121-004 – Liquid Libations: from Alcohol to Caffeine (Textbook: A history of the world in 6 glasses)

A&S 121-003 – Edible History and Physiology (Textbook: An edible history of humanity)

A&S 121-005 – Sex after 1978 (Textbook: Sex in the age of technical reproduction)

### Spring 2019 (Hybrid)

A&S 121-002 – Liquid Libations: from Alcohol to Caffeine (same textbook)

A&S 121-001 – Food-linked History and Physiology (same textbook)

A&S 121-003 – Sex and Reproduction (same textbook)

### Fall 2019 (Hybrid)

A&S 125-001 – Liquid Libations: Caffeine to Alcohol (same textbook)

A&S 125-002 – Food-linked History and Physiology (same textbook)

A&S 125-003 – Sex and Reproduction (same textbook)

### Spring 2020 (Online)

A&S 125-003 – Liquid Libations: Caffeine to Alcohol

A&S 125-001 – Food-linked History and Physiology (no textbook, PowerPoint and handouts only)

A&S 125-002 – Sex and Reproduction

## Modified TBL

Students who take late-starting classes at our University are generally happy to receive a second chance to maintain fulltime status. They appreciate the chance to increase grade points with tools like tRAT and team discussions, but they also voted to include traditional measures of learning, such as scheduled quizzes. This is the reason why, team-based instruction included one module per week, but each week didn't have its own RAP or 4S Application Exercise. Instead, four RATs were spread throughout short courses, with one 4S assignment (Table 1). Students in permanent teams followed TBL requirements at least once. Four essential elements and other basic aspects of TBL were followed.

## Results:

Table 1: Course Details

Courses included in this analysis	Semester	Course Type	Topic	# of students who completed the course	# of days with Roll Call (MWF) <sup>3</sup>	# of excused absences
1	Fall 2018	Hybrid <sup>1</sup>	Beverage	24	22	19
2			Food	27	22	5
3			Reproduction	25	22	1
4	Spring 2019	Hybrid <sup>1</sup>	Beverage	22	19	11
5			Food	18	19	9
6			Reproduction	24	19	3
7	Fall 2019	Hybrid <sup>1</sup>	Beverage	26	21	1
8			Food	24	21	15
9			Reproduction	23	21	14
1	Spring 2020	Online <sup>2</sup>	Beverage	15	21	0
2			Food	11	21	0
3			Reproduction	18	21	0

**Explanation:** For COVID-19, hybrid classes were switched to online a week after classes started in spring 2020. Online classes for 3 courses were compared to 9 immediately preceding hybrid classes over three semesters

- 1: Hybrid = Data for 3 courses on Food, Beverages and Reproduction were calculated for 3 consecutive semesters (Fall 2018, Spring 2019 and Fall 2019) . Classes included: Monday, Wednesday, Friday Face-to-Face in-class (synchronous), with Tuesday and Thursday Online (asynchronously, through Canvas)
- 2: Online = Data for 3 courses on Food, Beverage & Reproduction were calculated for Spring 2020. Classes included: Monday, Wednesday and Friday by Zoom® Communication virtual classroom (synchronously), with Tuesday and Thursday Online (asynchronously through Canvas)
- 3: Roll call was taken on Mondays, Wednesdays and Fridays for both Hybrid and Online Courses. Two days of roll call data are missing for Spring 2019

**Table 2: Online students reflect on TBL in their Final Survey**

	No	Yes	Yes %	<b>Explanation:</b> Online students like duplicate quizzes, learning from peers and breakout room discussions
<b>Was duplicate quiz (tRAT) helpful?</b>	3	32	<b>91.4%</b>	
<b>Will you take a TBL course again?</b>	5	29	<b>85.3%</b>	
<b>Did you like team work in Zoom Breakout Rooms?</b>	10	23	<b>69.7%</b>	

- 1: Not all students answered all questions
- Modified TBL has been used for late starting classes at our University at least since 2012
- All quizzes, unannounced and scheduled, were in duplicate
- The authors believe that hybrid to online transition was possible without major hiccups, because TBL requirements for hybrid classes (permanent teams, discussions, duplicate quizzes, application exercise) didn't need major revisions to switch to online learning, since TBL is conducive to extensive and intensive online experiences (Bryson, 2020). Other features of TBL (self-motivation, discussions, active participation, etc.) helped (Carillo, 2020)
- TBL is learner centric and requires an instructor to be a facilitator instead of an instructor. Online, it helped to be a guide, rather a teacher

**Table 3 (Final Survey): Students reflect on a speedy transition to online learning**

	No	Yes	Yes %	<b>Explanation:</b> Online students overwhelmingly appreciate the chance to take late starting classes
<b>University of Kentucky should offer more late starting classes</b>	2	29	<b>93.5%</b>	
<b>Transition to learn online was easy</b>	14	19	<b>57.6%</b>	

- 1: Not all online students answered all questions
- University of Kentucky has offered late-starting classes since before 2012. These classes help students maintain full time status, after dropping another class. It appears that these classes support online student performance

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- University of Kentucky has determined that students need around 30 hours of contact with teachers to earn two credits. Initially the primary author taught in-person classes (MWF) over 11 weeks, but realized that students were dropping classes later, after midterm. This made it necessary to condense late starting classes to 8-weeks in fall or 7-weeks in spring, maintaining the ~30 contact hour model
- Up to 30 students could register for each late starting class
- Even with around 50% students reporting that transition to online wasn't easy, online students were resilient and persevered. Around 60% online students received A letter grade, as did past learners in hybrid classes (Table 6).
- Student cooperation was essential

Table 4 (Performance): Online student comments

### **Table 4 (Final Survey): Typical examples of student comments <sup>1</sup>**

<b>Team Based Learning</b>	I figured out that I would want to have more classes as a TBL course because you get a better and more broad perspective on topics when you work with other people and they have different viewpoints as you
<b>Teamwork</b>	This class focused on team learning but also was the only class I have had that made me step out of my comfort zone and present on my own
<b>Online Course</b>	Sometimes you will have to work around obstacles. This online transition has been crazy! But I truthfully feel like it has taught us a lot about overcoming how to function better online in a class and how to work with others knowing that we are all dealing with a similar issue of being forced online. Online school is hard and requires more planning than in person classes, holding yourself accountable is very important
<b>Self-reflection</b>	You will only make it as far as you push yourself. Whether that is in this class in terms of how much we apply ourselves or in other aspects of life and school
<b>Self-improvement</b>	I liked how we would discuss and be questioned on the spot about it which helped further our knowledge of the topic we were discussing which will probably happen in life because there will be times you're put to the test in your work field
<b>Time Management</b>	I learned how to use time management, and make sure the next time I take classes that have a lot of assignments, I will write them all down in a planner, and make sure that I am aware of all due dates. I can use this in the future, by making sure that I am prepared for work meetings and other Assignments that are due in my classes

- 1: Students were requested to reflect on three positive lessons learned in class. The most thoughtful or thought-provoking answer is included
- It appears that reflections support student performance
- Undergraduate students from any discipline or year can take these late-starting classes. With a wide range of students, these courses focus on process as well as course content. Focusing on process helps prepare students for other courses at the University or later during work-life. Life skills like time-management, basic research processes, public speaking and working with team members are all hallmarks of TBL

Table 5 (Performance): Online students took advantage of extended deadlines

**Table 5: Online students submitted assignments late for all but one task**

#	Assignments (Grade / Assignment) Total = 100%	Course Type	# On Time <sup>3</sup>	# Late <sup>4</sup>	Total # <sup>5</sup>	% students late for Online	Fisher's Exact Test <i>p</i>	Explanation: We didn't know what sort of internet disruption to expect in the Spring of 2020. So, only for online courses, deadlines were extended to the last day of class. Most students took advantage of this extension
1	Outline for the Research Paper (2%)	Hybrid <sup>1</sup>	185	2	187		<0.05	
		Online <sup>2</sup>	6	24	30	80.0%		
2	Research Paper (15%)	Hybrid <sup>1</sup>	189	0	189		<0.05	
		Online <sup>2</sup>	23	18	41	43.9%		
3	Speech (5%)	Hybrid <sup>1</sup>	149	2	151		<0.05	
		Online <sup>2</sup>	19	10	29	34.5%		
4	Role Play (10%)	Hybrid <sup>1</sup>	188	2	190		<0.05	
		Online <sup>2</sup>	17	17	34	50.0%		
5	Poster (4S Application Exercise, 15%)	Hybrid <sup>1</sup>	195	1	196		<0.05	
		Online <sup>2</sup>	26	10	36	27.8%		
6	Unannounced RAT 1 (2%)	Hybrid <sup>1</sup>	189	2	191		<0.05	
		Online <sup>2</sup>	34	5	39	12.8%		
7	Unannounced RAT 2 (2%)	Hybrid <sup>1</sup>	189	6	195		>0.05	
		Online <sup>2</sup>	34	0	34	0.0%		
8	Unannounced RAT 3 (2%)	Hybrid <sup>1</sup>	162	4	166		<0.05	
		Online <sup>2</sup>	31	5	36	13.9%		
9	Unannounced RAT 4 (2%)	Hybrid <sup>1</sup>	150	5	155		<0.05	
		Online <sup>2</sup>	5	5	10	50.0%		
10	Duplicate Quiz A (15%)	Hybrid <sup>1</sup>	190	3	193		<0.05	
		Online <sup>2</sup>	35	5	40	12.5%		
11	Duplicate Quiz B (20%)	Hybrid <sup>1</sup>	Comparison not applicable. Assignment was due the on last day of class. Late submission wasn't possible					
		Online <sup>2</sup>						
12	Peer Review (5%)	Hybrid <sup>1</sup>	Comparison not applicable. Assignment was due on the last day of class. Late submission wasn't possible					
		Online <sup>2</sup>						
13	Reflective Survey (5%)	Hybrid <sup>1</sup>	Comparison not applicable. Assignment was due on the last day of class. Late submission wasn't possible					
		Online <sup>2</sup>						

- 1: Hybrid = Data for 3 courses on Food, Beverage and Reproduction were calculated for 3 consecutive semesters (Fall 2018, Spring 2019 and Fall 2019). On MWF, classes were face-to-face, while on TR, classes were online through Canvas
- 2: Online = Data for 3 courses on Food, Beverage and Reproduction were calculated for Spring 2020. On MWF, synchronous classes were by Zoom® virtual classroom, while on TR, classes were asynchronous, through Canvas
- 3: Online deadlines for assignments 1 through 10 were extended to the last day of class to support our university policy of flexibility in Spring 2020. Since assignments 11 through 13 were due on the last day of class, an extension wasn't possible. Student performance appeared to be helped with deadline flexibility
- 4: Hybrid: Thirteen Assignments were spread throughout 7 weeks in Spring and 8 weeks in Fall. For these courses, late submission of assignments was accepted only with verifiable excused absence documentation.

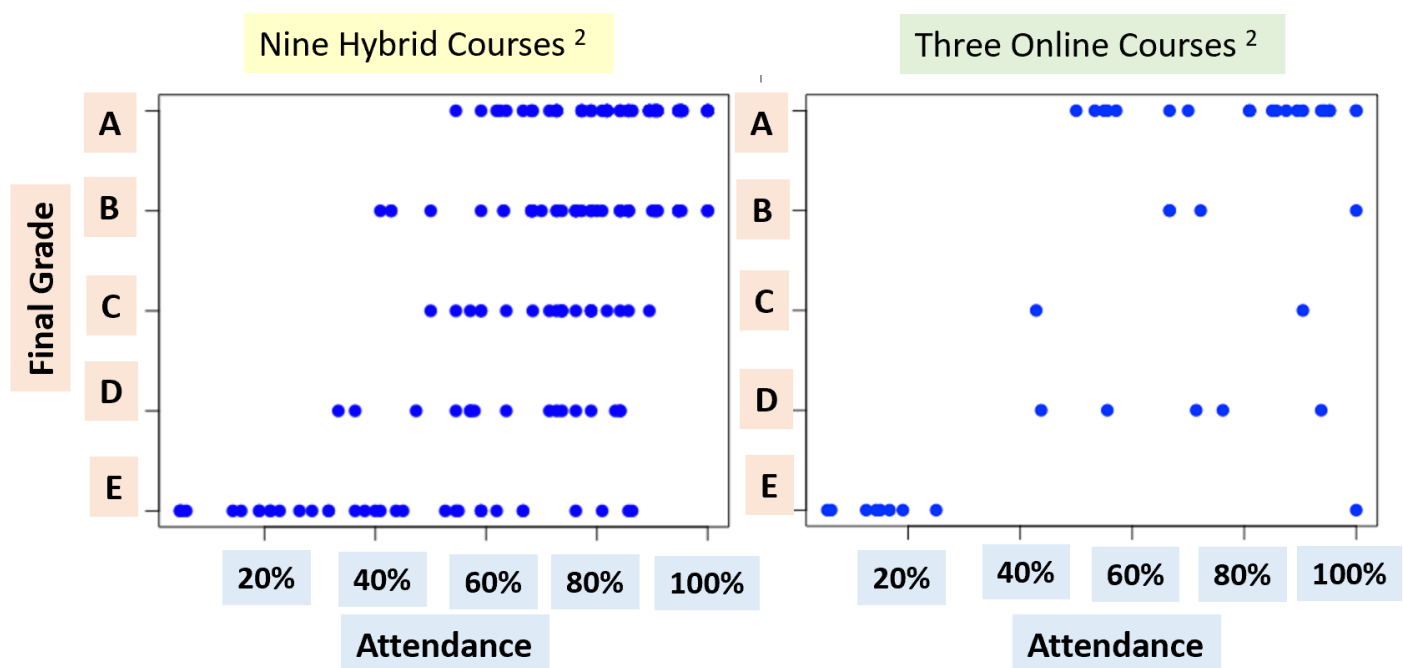


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- 5: 213 students registered for nine hybrid classes and 44 students registered for 3 online classes (Table 2), but number of students in this column is less, since all students didn't complete all assignments, even after extending online assignment deadlines to the last day of class
- Each student received an individual topic for research and write up in the scientific writing style. Scaffolding was used to teach the art of writing in gradual steps, first the outline, then the paper
- Different learning styles were taken into consideration when designing these courses (speech, role play, writing)
- For the 4S application exercise, teams worked on the same significant problem, with specific choices, and reported specific claims and solutions simultaneously in a gallery walk format. For hybrid, team members huddled and created paper posters in class. For online, a representative from each team submitted a poster online simultaneously
- Both scheduled and unannounced quizzes were in duplicate, following TBL processes. First students took individual quizzes (iRAT) on Canvas, with their Zoom® video open. Then teams huddled in Zoom® breakout rooms and one team member (test taker) completed the quiz (tRAT) after team consensus. The instructor manually filled in grades for other team members later
- Peer review is required by TBL and allows learners to reflect on their commitment to supporting team members
- A survey due on the last day of class allowed students to reflect on their performance throughout the course

Table 6 (Performance): Relationship between attendance and final grade

**Table 6: For hybrid and online groups, students who “came to class” received better final letter grade <sup>1</sup>**



**Explanation:** Transitioning from Hybrid to Online didn't affect overall student grades. Example: for both formats equally, attendance was associated with final Letter Grade

- 1: Attendance was taken in-class for Hybrid courses on Mondays, Wednesdays and Fridays, but were on Zoom® for virtual classroom for Online courses
- 2: Ordinary Least Squares (OLS) regression analysis was performed separately for Hybrid and Online courses relating Final Letter Grade to Attendance.  $P < 0.05$  for both scatter plots.

- To determine if overall student performance was affected by the sudden online shift, relationship of final grade patterns to roll call (MWF) or synchronous education, was assessed. With the same positive relationship of attendance to final grade in both groups, it appears that overall performance didn't depend on the mode of teaching – hybrid or online. In other words, attending class can be a significant predictor of success.
- Roll call was taken on Mondays, Wednesdays and Fridays for both Hybrid and Online Courses. Two days of roll call data are missing for Spring 2019

Table 7 (Performance) Online students reflect on open ended questions

### **Table 7 (Final Survey): Six top emerging themes with reflective responses from online students to open ended questions<sup>1</sup>**

	# students responded	% Responded	Thoughtful Comment	Explanation
<b>Extension of deadline was helpful</b>	24	<b>77.4%</b>	Extensions of the deadlines helped me a lot with especially with having to transitioning to online	Most assignment deadlines were extended to the last day of class
<b>Glad we didn't have a textbook</b>	18	<b>58.1%</b>	No textbook. I had no idea from where I was going to get funds for the book	Textbooks were not required, only for Spring 2020 classes
<b>Instructor flexibility helped with online transition</b>	10	<b>32.2%</b>	The way lessons were available whenever the students were along with the assignments was very helpful	Instructor flexibility included extending deadlines, increasing student consultation, voting on Zoom to consider student points of view, extra credit
<b>Students liked instructions through Zoom</b>	9	<b>29.0%</b>	I liked the Zoom classes as well because I liked how we could enter our breakout rooms	Breakout rooms were used for tRAT, team discussions, 4S application exercise, and role play practice
<b>Class structure was helpful</b>	6	<b>19.3%</b>	The instructor was helpful but not parentlike	Our University allowed us to revise class syllabi after starting classes, only in the spring of 2020. Class stucture was maintained with flipped class, consistent expectations, encouraging students to be proactive and enticing regular attendace with extra credit and discussions
<b>It was easier to learn from home</b>	5	<b>16.1%</b>	It was nice to be able to join this class with peace knowing that I didn't have to worry about walking far and being late for class	Joining Zoom class from any place was fine as long as all videos were on and the instrutor could see each student during the length of the class

- 1: Thirty-one students responded out of 44 online students in 3 courses in the spring of 2020. Data was collected from the final survey, showing that these parameters helped with student performance online
- Extending the deadline was appreciated by students, but naively, the instructor didn't expect most students to take advantage of this flexibility. In the fall of 2020 for the same classes, deadlines were extended for 7 days
- Only in the spring of 2020, textbooks weren't required. Textbooks were added back to courses in the fall of 2020



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- Students appreciated that the instructor for these late starting classes was available by email appointment on Zoom® or by set office hours on Zoom® (renamed student hours)
- Surprisingly, students liked meeting by Zoom®, with their video on and presence recognized with roll call. More than one student mentioned that synchronous classes were much better than asynchronous or pre-recorded classes
- Learners mentioned during informal discussions, that they liked the class structure for these late-starting classes as these classes required active student participation, duplicate exams, teams, team discussions and active assignments, all hallmarks of TBL

Table 8 (Performance): Extra credit

**Table 8: No difference of extra credit<sup>1</sup> received during hybrid or online**

	Hybrid Average for Nine Courses	Online Average for Three Courses	$p$	Statistical Test
	Average Points Earned (Range)	Average Points Earned (Range)		
Extra Credit	12.83 (0 - 17.5)	17.58 (0 - 19.5)	> 0.05	Welch's 2- sample t-test

**Explanation:** Students earn extra credit for active participation through discussions, homework, extra analysis, critical thinking, teamwork, film review, attendance, etc. It appears that extra credit is necessary for late-starting classes to entice often apathetic students, who have dropped another class. Transitioning from hybrid to online didn't appear to affect extra credit as a measure of overall student outcome. Example: In both groups, average extra credit earned was similar, with a wide range as some students didn't take advantage of extra credit (zero), while others earned enough to advance final letter grade scores.

- 1: Around midterm, students take late starting classes, overwhelmingly, after dropping other courses. Some of these students are resistant to courses which may not have anything to do with their major subject of study. To motivate such students, learners are given an alternate opportunity to earn grade points to cultivate life skills, reinforcing course content with practical knowledge, which should help during work-life
- Learners earn extra credit points by taking active part in discussions with other team members, with the instructor, or by completing homework TR as a flipped class exercise for next day in class. In addition, learners can earn credit for reviewing a film linked to the course, or even for reviewing software that is provided free of cost by our University. As an example, Read&Write, developed by Texthelp systems can increase reading comprehension, writing prowess or even convert speech to text (<https://www.texthelp.com/en-us/products/read-write/>)

Table 9 (Instructor Effort)

### **Table 9: Transition from hybrid to online teaching required higher instructor effort per course<sup>1</sup>**

	Hybrid Average for Nine Courses	Online Average for Three Courses	Online Effort % higher	<i>p</i>	Statistical Test
	Instructor Effort per Course (hours)				
Instructor Training	6.72	52.15	87.12%	<0.05	Welch's 2 Sample t-Test
Syllabus Preparation & Revision	5.13	11.00	53.37%		
PowerPoint Preparation & Revision	16.50	26.67	38.14%		
One on One interaction with Students	11.94	19.00	37.16%		
Course Preparation & Revision	52.50	75.00	30.00%		

**Explanation:** Quick transition from Hybrid to Online teaching was possible in the Spring of 2020. Increased Instructor effort was most needed for personal training to swiftly learn Zoom, Canvas & Yuja Media, etc. Additional time was necessary to revise class material and assist students adopt to new learning techniques

- 1: Three courses are taught in Spring and four, in Fall. This is the reason why, the fourth course was removed from calculations, then instructor effort *per course* was calculated first and finally statistical analysis was performed
- Continued support of teacher education through learning communities (like CELT) appear to be key to online teaching (Carrillo, 2020). CELT provided teacher education, moral support and camaraderie. Most constructs of faculty readiness (Ackerman, 2021) were also applicable (comfort with risk, willingness to learn, confidence to be flexible and creative, strategies to manage fear, sense of self as a teacher, etc.)
- For prompt online migration, phases of instructor preparation, as described by Kim 2020 were followed. Phase 1: planning was very short, 24<sup>th</sup> February through 22<sup>nd</sup> March 2020. Phase 2: implementation, continued until the last day of class, 1<sup>st</sup> May 2020. Phase 3: reflection continued throughout the first two phases, until writing this article
- Experience acquired before the pandemic: The instructor already had some online teaching experience, through asynchronous classes on Tuesdays and Thursdays, including familiarity with basic knowledge of Canvas use (announcement, assignment, grading, modules, pages, people and syllabus), Microsoft Word, PowerPoint, Excel, Microsoft OneNote
- New Experience developed in Spring 2020: Zoom<sup>®</sup> Communication, Yuja Media, Canvas: quiz, Yuja link, Zoom<sup>®</sup> link

### **Justification for Statistical Analyses:**

We selected the following statistical tests to compare data for hybrid and online teaching. Sample size was small for online courses, as less numbers of students registered (Table 1) and data from only one semester was available for this initial case study. For low sample size overall, Fisher's exact test was chosen for statistical analysis. Comparing data in contingency tables was deemed to be adequate. With the same assumptions (sample distribution normality, unequal sample distribution variances), Welch's Two Sample t-test was used as well. This test assumes that the sample has been derived from a normal population. We proceeded with caution while using this method. To assess if students in both hybrid and online groups had similar opportunities to earn grade points, grade patterns were assessed against attendance, a key indicator of performance in the past. Since this could be considered as the analysis of two comparative experiments, where two learning modes are compared, two-factor ANOVA statistical analysis was performed to find no significant difference (data not included as a graph in this presentation). As another measure of student performance, we analyzed the relationship between student attendance (in-class for hybrid and Zoom<sup>®</sup> for

online) and final grade. For this analysis, individual student grades were converted to GPA, then an ordinary least square (OLS) regression analysis was performed. Statistical analysis for Table 9 (Instructor Effort), needed a bit more consideration as 4 courses were taught in fall and three in spring. Data associated with the 4<sup>th</sup> course in fall was removed, then total data was divided into thirds to get hours per course and only then statistical analysis was performed.

Quick transition from hybrid to online learning due to COVID-19 was possible for three main reasons. First, modified **TBL**, was in use as a teaching strategy for over seven years prior to the sudden switch. This learning method helped students work in permanent teams, be proactive, support each other, and learn through modules and active assignments. Students in late-starting classes also appreciated tRAT (duplicate team quizzes), many Zoom® main room/breakout room discussions and the 4S Application Exercise. Second, University of Kentucky provided excellent support for instructors during the spring break in 2020 and through the rest of the semester through **CELT**, University of Kentucky's key teacher training services and its outstanding consultants. Third, **students** were resilient, quickly learned Zoom® without prior experience and cooperated with the instructor, who in turn, had to spend more time for the necessary and unavoidable switch due to COVID-19.

- **4S application exercise** – Each TBL team worked on the same (S1) significant (S2) problem, using a specific (S3) choice. Teams reported specific claims and solutions simultaneously (S4). These four elements made up the basis for 4S TBL application exercises. For courses included in this case study, the following were used in a gallery view format –
  - Food – Producing a nutritious but inexpensive dinner for a University student on a budget
  - Beverage – Drinking water and related physiological, mental, social, sociological issues at Flint City, Michigan
  - Reproduction – Scientific, cultural, sociological and other aspects of human reproduction
- **Canvas** – Canvas by Instructure (<https://www.instructure.com/canvas/>) is learning platform used by University of Kentucky. For our courses, all PowerPoint slides, syllabi, handouts and quizzes were uploaded to Canvas. Zoom® and Yuja were linked through Canvas as well.
- **CELT** – Center for Enhancement of Learning and Teaching (<https://www.uky.edu/celt/>). Dedicated staff of this unit provides timely training through one-on-one consultation, office hours, workshops, faculty learning communities, web liked resources (<https://teachanywhere.uky.edu/>) and more. No question. Quick transition from hybrid to online was possible for their dedication to teach us fast.
- **Flipped class** – Complying with TBL, students were requested to learn course material (textbook, handout, homework, etc.) before coming to class. Comprehension was assessed with four unannounced RATs.
- **GPA** – Grade point average
- **Hybrid Classes** – For our courses, hybrid included face-to-face classes on MWF. PowerPoint slides were uploaded to Canvas after class. Students had access to PowerPoint slides asynchronously on TR
- **iRAT** – Individual Readiness Assurance Test, taken before tRAT
- **MWF** – Mondays, Wednesdays and Fridays
- **Online** – MWF on Zoom® virtual classroom, synchronously, with roll call and all videos open for discussions with eye contact. PowerPoint slides were uploaded to Canvas after class. On TR, PowerPoint slides were uploaded to Canvas for asynchronous learning
- **RAT** – Readiness Assurance Test. In compliance with TBL, duplicate (individual followed by team quizzes) tests to assess comprehension of course material
- **TBL** – Team Based Learning Collaborative (<http://www.teambasedlearning.org/>)
- **TR** – Tuesdays and Thursdays

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- **tRAT** – Team Readiness Assurance Test, a signature addition to TBL. This quiz is taken immediately following the quiz taken by individual students (iRAT). For tRAT, team members huddle to agree on the correct answer. Students included in this case study liked tRAT (personal communication) as their grades could be elevated because of team discussions.
- **WHO** – World Health Organization (<https://www.who.int/>)
- **Yuja** – video capturing and editing cloud based platform (<https://www.yuja.com/>). For online courses, all Zoom® classes were recorded, then accessed through Canvas and edited by Yuja
- **Zoom®** – This online cloud-based meeting platform (<https://zoom.us/>) was used to hold online classes. This platform was accessed through Canvas. Chats were used for short answers. Polls were used for surveys and student votes. Breakout rooms were used heavily by team members to discuss tRAT answers or other discussions.

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