From Classroom to Online Education – An Educators Insights

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Face-to-face activities at universities became difficult in the spring of 2020 with the worldwide outbreak of the SARS virus version COVID19. Within a short period, all face-to-face classes were cancelled and replaced with remote lectures utilizing online Learning Management Systems (LMS) and video conferencing. The large scale of online education has exposed a number of problems and challenges that although somewhat known have taken on greater significance. This paper describes online teaching models, learning styles, engagement and interaction models to create a foundation for a set of patterns that capture ways of dealing with these problems – solutions that have been developed and applied for online education even before the pandemic hit but are now being more broadly used. Definitions of user experience may be vague and conflicting, as each student and school is unique. The motivation of this paper was the pandemic; however, the findings show engagement as being positive, and yet still exploratory. This work contributes to the understanding of how we can apply patterns for online education and shows the start of a whole new pattern language as we move forward with a new educational model.

Categories and Subject Descriptors:

General Terms: Online education, distant learning, on-line teaching, student engagement, patterns

Additional Key Words and Phrases: Learning Management Systems **ACM**

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1. INTRODUCTION

It has been over a year now since the pandemic forced us to switch from face-to-face to online teaching. The way we do our jobs totally changed overnight, and we had to learn fast and hard how to create a solution for our students so that they could continue their semester and their learning path.

Online learning is not a new concept, for example, Nova Southeastern University in Ft. Lauderdale Florida has been around since 1985 with the first fully accredited online graduate program [NSU2021]. MIT launched in 2002 their OpenCourseWare project to provide free MIT courses to people worldwide [MIT2021]. But before the need for social distancing caused by the 2020 pandemic made online learning mainstream, it was considered "bad", like taking a correspondence course. Do you really learn anything worthwhile? Would anyone hire you? In the past, some employers would not consider someone with a degree from a totally online program in certain fields. It has been suggested that online learning is less credible than learning in person.

As we are gaining experience with remote education and the various models for implementation it is probable that even if/when face-to-face education can resume for many students, the emerging benefits of online offerings

will mean that a number of students will prefer this model, and education organizations will continue to support it.
This paper addresses the questions an educator is asking when transitioning to teaching online:

- How does your approach change when you teach online?
- What makes for a good online course?
- How does the online teaching and learning environment differ from the in-person one?

The paper starts with my personal story of what happened as I was teaching at NY colleges when the pandemic hit, how we gradually have figured out a path forward, and the obstacles and solutions encountered along the way. I then give some background on online education models, and a structured presentation of challenges for educators and students. Pattern mining techniques were used to identify common solutions to online education in various areas: technical, security, engagement, and design of online courses. I present a map of these patterns and include two patterns in each category, with the plan to present additional patterns in future papers.

2. MY STORY AS AN EDUCATOR IN 2020-21

In the Spring of 2020 I was teaching face-to-face courses in computer science and mathematics at New York colleges. At that time it was frowned upon to teach remotely. Remote teaching was considered too much work for the faculty. There was also a common opinion among most faculty that this model was not conducive to the students' learning and it was too vulnerable in respect to opportunities for cheating. When the pandemic hit New York, these worries were soon irrelevant as we were scrambling to move to online teaching only — as fast as we could make it happen.

My teaching assignments were one master's level course, Info Systems Development Professional, which is Project Management for business students where most of them are accounting majors. The schedule taught was two sections of Intro to Computer Security at another school in the same University System. Some were obtaining associate level degrees, some bachelors. Some students are military veterans. This is a different audience, as they aspire to become database or networking professionals. Additional classes included two courses at a private school, St. John's University, in Queens, NY. The courses were Intro to Data Structures (Java). Another course was Software Engineering to graduating seniors also at the undergraduate level.

The first semester started out in person, seeing each other's faces, and getting to know each other. Being able to interact with the students in the classroom, one could tell by their posture and facial expressions what they were thinking and feeling. Reflecting to this period one may realize how valuable these non-verbal clues are for the educator. They show if people are comfortable to move on or if we need to spend more time on a topic, they tell me if we need to follow up with some students individually, and if we need to modify our teaching methods.

The face-2-face meetings went on until March 11, and then all my classes were switched to teaching remotely. During the initial phase, the focus was on the logistics and setting up the technology to be able to hold classes and communicate with the students online. Because I was teaching classes at three colleges and needed to use the tool that the school was endorsing, I had to learn three different software tools for holding remote sessions: Collaborate Ultra, WebEx, and Zoom. Each one had strengths and weaknesses.

March 12-31 was an exceedingly challenging time where we were establishing a new routine and adjusting our teaching and ways to collaborate with students and with the faculty. The technology was new, and bugs were discovered. But the hardest part was the interaction with the students. Group efforts made it hard to decipher actual individual learning. In speaking with students individually to find out whether they were doing any work/working in groups was an eye opener. One school told us that the students must turn on the camera. They were very reluctant to do that, but they did it. But then we were told that we could not enforce the use of cameras, so that suddenly stopped (no more video). One student in the Software Engineering class asked if they could do no more work and just get A's. This made me aware that some students were giving up, and I could sense that some resignation was developing in the class. But other classes were doing better. Most of the students wanted to get through it together and help me get through it with them. The master's students were the best and most mature. They did the most online presentations, and this was particularly good for class time online. I found the

Spring final exam grades to be higher than usual. My exams were: T/F, Multi Choice, and fill-in the blank. Students were really fighting for A grade. I gave way more A- than usual. I was secure that I was able to get through to most of the students in the Spring and taught all the required material.

I spent my summer learning a new Learning Management System (LMS) called Canvas that was used at St. John's University. I was also told the CUNY system would be switching to this LMS in one year. On July 6, I thought my schedule for the Fall Semester would include Computer Architecture, Computer Programming Fundamentals 1, and Intro to Data Structures again at St. John's University. No (new) course changes for the other schools, except for grading changes for the Intro to Computer Security. I also changed to a newer book for the master's class. I was counting on teaching the data structures course again but that was changed. Then the computer architecture course was reassigned to a full-time professor. I was down to only one class, the computer programming fundamentals. At the last minute someone quit, and I was assigned College Algebra, and then a teacher did not show up to his first Calculus class and I was back to teaching 3 classes. Only now I was not prepared or even had the books. I started to use eBooks and teach new courses online for the first time. On top of that I had connection problems. The time of day seemed to matter. I contacted my internet provider as well. I muddled through the semester with all the major and minor changes. Again, the students seemed to only care about the end result. Although students in my Intro to Security class and Computer Programming class praised me along the way which helped me keep my motivation up.

In the Fall semester I started experiencing major problems with participation and testing. Many students signed into the class session and did nothing after that. They did not turn on the microphone or the camera. This makes teaching extremely hard. You do not know if they walked away. It really feels like teaching in a void. I asked students to read in advance. The majority did not read. I asked them to take turns reading in class. The same few students volunteered. It is harder to call on students in the online environment, not knowing if they are even there or just signed in. To boost participation, I tried to use white board, polling, and breakout groups online. Getting the students to respond to a poll was challenging. They mostly did not respond. The group project with mandatory participation helped. This showed me that we as educators must really think and change techniques, so students do not hide in the online class. I remember as an undergraduate we had large lecture halls with 300+ students. But we also had a lab with 24 students. Online teaching style must be adjusted to maximize control of the class and emphasize the effectiveness of the learning environment. I found meeting the students and being able to put a face to the name is helpful. But even with that said, St. John's University provides a detailed roster with the photo of the student. We should also have academic transcript information, so we know what kind of student they really are. This is yet to be provided. I used to have this information years ago.

I changed the way I created the final exams for the Fall semester. The midterm exam grades were very (too) high. For the finals, I used an essay and" fill in the blanks" only. I was surprised to discover the answers given by some students were the exact answers in the test bank. The computer fundamental group had the same variable names and code. This shows collaboration during the exam. The Algebra math class was given a 50 question, 2hour exam. I spoke with a colleague that gave students one whole week to do the final exam. I only gave 2-hour exams if the school gave a time slot or the class period. 1.5 hours or 3 hours maximum. Testing is another area that needs rethinking for it to work (with minimum cheating) in an online setting.

The Spring 2021 semester has been extremely busy but in a good way. I am successfully juggling 6 classes. A difficulty of being an adjunct professor is not having preference to courses, so I take what I can, and classes are often assigned late. My schedule changed up until the very beginning of the semester. Two of the classes are brand new to me which means more preparation. I am teaching one math course in Algebra and Trigonometry that is fully online. It was designed to be fully asynchronous, with no teaching sessions. It is the first time that I adhere to this model, and "breaking the rules" I created 4 Zoom meetings: a kickoff meeting in January and a 1 hour meeting each week for the first four weeks. It was difficult to get all together as the class was listed as asynchronous. The students were pushing back on the joint sessions, and the technology was not good either, so I soon abandoned trying to meet with them on a regular basis. I am glad I did, but It took some changing of my own mindset to get used to letting go. There was an expectation from the school to provide recordings for teaching this class, but the period and poor available tooling made this impossible. The school underestimates the preparation and technology required for instructional videos. Although I did not record any lectures, I did add voice thread to the book PowerPoint files.

For the math class and a class in Data Structures I am using a solution called ZyBooks that offers participation activities and challenges, and even labs for the data structures class. I assigned all ZyBooks materials in addition to the original course books as these replaced the face-to-face meetings. I liked using ZyBooks, and the students eventually came to appreciate it too. The only problem was when the students did not complete by the deadline. It was extremely hard to update the grades in the LMS (Canvas).

I also got an opportunity to experience online learning from the student's perspective when I took an intensive 3-week training in April. The Online Teaching Essentials workshop is a CUNY-sponsored program to prepare faculty for online and hybrid course instruction, offered by the faculty development team at the School of Professional Studies (SPS). The workshop is conducted fully online in the Blackboard LMS, with activities and assignments that can be completed on a flexible schedule (asynchronously) within each scheduled module. Currently, there is no direct registration for the workshop; participants are nominated by their campuses. Familiarity with basic functions of Blackboard is required. I wrote my request letter to my college, and I was accepted. Designed to give the participants first-hand experience of what it is like to learn online, including the flexibility of asynchronous instruction, the course included modules like Understanding the Online Learning Environment, Structuring the Online Learning Experience, Communicating and Interacting Online, Online Presence and Engagement, Effective Online Assessment, and Course Schedule and Reflection.

I feel more prepared for the Fall 2021 semester having attended this training. It helped strengthen my work on this paper. In each module, participants review resources related to the topic, engage in discussions with peers in the same or a similar discipline, and complete practice exercises. Experienced online faculty serve as peer facilitators guiding small groups through the discussions and Blackboard exercises. The final project is a draft course schedule and syllabus that serve as a plan for teaching an online course. I also had a follow-up session with a live instructor, who mentioned a tool, H5P.org, which allows you to create, share and reuse HTML5 content in your browser. I plan to explore the new tools and techniques for the fall semester, and in general invest my time into the new material and engaging the students.

3. EDUCATIONAL CONCEPTS, DEFINITIONS, AND MODELS

As for classroom education, online education needs to be built on a shared understanding of educational principles and consider the people involved - educators as well as students. There are a variety of teaching models and colleges are not always applying the terminology consistently. So, to make sure that the contents are clear to the readers of this paper it is necessary to define some concepts and explain the models for remote education as applied in my work.

Although the current need for online education was driven by the pandemic, there are other factors that may result in a higher level of remote classes to continue for the longer term. In many ways, the taboo is broken in that we have proven that with proper course design and tooling the remote model can work for mainstream higher education. One can foresee a future with a variety of models to accommodate the needs and wishes of students and educators. The online model has the benefit of making education available to a broader audience, although for some topics and for some personalities a classroom solution will be necessary. Several hybrid models will emerge, and some of these have already been around for a while for more specific purposes. For example, executive MBA courses, where some of the coursework is done remotely with periods of immersive classes on site for shorter periods to enable students to take the class while continuing to work.

3.1 Teaching Models

Definitions and explanations of teaching models may vary depending on the source. The below is an overview of online teaching models and terminology as applied in this paper.

Asynchronous: "Asynchronous instruction is when teachers post the readings, videos, and other materials online before the class period, and students respond to essay prompts, problems, quizzes, etc., by a given due date/time. [Qu2021]"

Synchronous: "Synchronous learning is a learning event where the learner and instructor are in the same place at the same time. [UB2016]" This can be in a face-to-face classroom or a web conferencing application.

Hybrid/Blended: "'Blended Learning, also referred to as 'Hybrid Learning,' combines traditional face-to-face classroom instruction with online learning. [HM2004]"
Flipped: "The flipped classroom is a pedagogical model in which the typical lecture and homework elements of a course are reversed. Short video lectures are viewed by students at home before the class session, while inclass time is devoted to exercises, projects, or discussions. [Edu2012]"

HyFlex: "The hybrid flexible, or HyFlex, course format is an instructional approach that combines face-to-face (F2F) and online learning. Each class session and learning activity is offered in-person, synchronously online, and asynchronously online. [Edu2020]"

3.2 Learning Styles Vs Teaching Models

An important aspect of education is the realization that students are quite different in their way of learning, and to be successful as an educator you need to consider a variety of learning styles. We have visual learners, auditory learners, and kinesthetic learners. Visual learners gain knowledge through visual inputs, auditory learners learn through listening, and kinesthetic learners learn through experiments and exploration. Humans have the cognitive ability to acquire and recognize information, map them to representations and to use them.

As we are moving from a classroom environment to a virtual setting, we need to be aware of the impact of this change and to be mindful about the different learning styles of our students. Course design can be made to accommodate for different learning styles by diversity in the content and how it is presented, and by providing alternative paths to the knowledge.

These are some learning types to consider:

Active - prefers to try things out, interacting with content and people, working with others in groups.

Global - prefers holistic thinking, systems thinkers, learns in large leaps.

Intuitive - prefers conceptual thinking, innovative, concerned with theories and meanings.

Reflective - prefers thinking things through, working alone or with familiar partner.

Sequential - prefers linear thinking, orderly, learns in small incremental steps.

Sensing - prefer concrete thinking, practical, concerned with facts and procedures.

Verbal - prefers written and spoken explanations.

Visual - prefers visual representations, pictures, diagrams, and flow charts.

A learning style model introduced by Kolb [Mc2017] in 1984 is shown in figure 1. This model focusing on the learner's internal cognitive processes defines a learning cycle with four stages – concrete experience, observation and reflection on the experience, formation of abstract concepts, and testing in a future scenario.

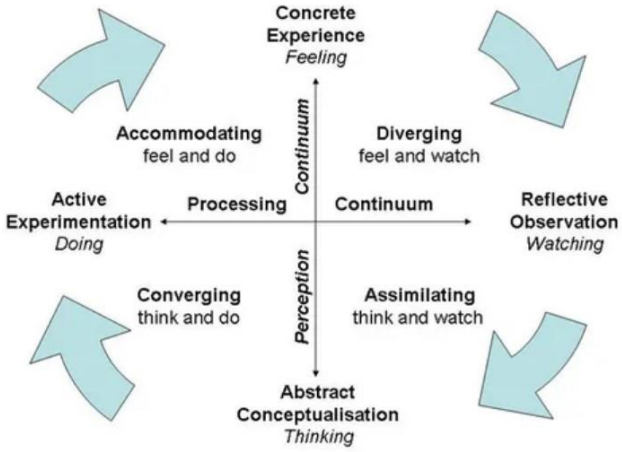

Figure 1: Kolb's Learning Styles

All stages must be completed for effective learning to happen. The four learning styles – diverging, assimilating, converging, and accommodating are a product of the two continuums provided by the east-west axis for processing (how to approach a task) and the north-south axis for perception (emotional response to a task).

Diverging (feeling/watching) – tend to gather information by observing and use imagination to solve a task, prefer to have many viewpoints, like brainstorming and working in groups, open to listening, interested in people.

Assimilating (watching/thinking) – prefer a logical approach where ideas and concepts are important, less focused on people, like readings and lectures rather than practical input, want time to reflect.

Converging (thinking/doing) – like technical tasks, not so concerned about people and interaction, good at finding practical uses for ideas and theories.

Accommodating (doing/feeling) – rely on intuition rather than logic, like hands-on tasks and rely on others for the analytical effort. This style is the most common in the general population.

Understanding the learning style of students is important in how to design classes and in mentoring of individuals. To develop activities and material that draw on abilities from each stage of the experiential learning cycle and that take the students through the whole process in the right sequence should provide the best learning progress for the various learning styles.

Online teaching is mostly structured to mimic the "classroom" learning environment where students are on a specific timeline and feel they are present as a group. This philosophy has evolved into meaning that online teaching must have a high interaction with students using email and chat. However, knowing the type of learner the student is, meaning how they respond the best to the material presented in a virtual classroom matters. Students should be offered different options during the courses to stimulate learning and increase comprehension, and the educator should attempt to getting to know each student and realize their learning style.

3.3 Engagement

One of the biggest challenges with online teaching is student engagement. It can be difficult enough in a classroom setting to gain the trust and commitment from every student to maintain some level of participation. Even when having a lecture in an auditorium you will have visual feedback and some idea of the students paying attention. Online is like speaking in a void, unless you enforce the use of cameras which is not necessarily possible both for privacy reasons and due to bandwidth capacity.

What do we mean by 'engagement'? Building opportunities for students to engage and find academic success. Student engagement happens in the present tense. It is when students are motivated to work on/with the material in the course. Engagement has impacts (future tense) as well as causes (past tense) that include but are not exclusive to the course or even students' academic careers. Engaged students tend to do better academically across all courses and in future careers. There is more to student engagement than instructors building engaging courses because factors include: structural, psychosocial, and sociocultural. For the student structural: background, family, support, life load, are all factors. The University: culture, policies, curriculum, assessment, discipline.

3.4 Interaction Models

When replacing the physical classroom with an on-line mode it is important to consider the various interactions that are taking place and how these will change. Your own interactions with the students as an educator are especially important, but one should not forget the need for student to student and student to content interactions. Here are the most essential interactions to consider:

Student ↔ Faculty

A few examples of the interaction between the student and the faculty include:

- providing feedback on assignments, learning journals, or other reflective activities
- participating in discussion forums or chats
- sending frequent announcements to summarize the previous week or describe the next week
- providing online or telephone office hours
- mentoring individual learners
- working with small groups of students assigned to help teach portions of the course (peer teaching)

Student<–>Student

Interaction between students can include formal course-related collaboration and interaction as well as more informal social interaction, which can increase students' comfort with each other and with the online environment. Student↔student interaction-based activities include but are not limited to:

- group projects
- group case studies
- peer instruction
- role playing
- synchronous or asynchronous discussions or debates
- collaborative brainstorming
- peer review of selected work

Student<–>Content

This interaction includes students' concrete interactions with the course materials and their more abstract interactions with the concepts and ideas they present. It is more than just reading a book or watching a video. It includes but is not limited to:

- tutorials (using text, still images, audio, and/ or video)
- quizzes (if the feedback is useful and usable)
- web quests (Links to an external site)
- reading/video discussion or reflections

(explicitly requiring students to reflect on the reading and providing directed prompts for that reflection improves the interaction)

- simulations

3.5 Motivation

For many students, schools are a place of stability, where they can learn, grow, and nurture relationships. Even though we must be physically distanced to slow the spread of the coronavirus it does not mean we have to be socially disconnected. While it is common for people to withdraw or turn inward in times of stress, isolation from support networks and communities can be damaging to our overall wellbeing. The way we frame our feedback needs to motivate students to continue to engage. We need to have ambitious standards, assurance they can meet the standards and support them. Students need a sense of belonging. A sense of belonging in an online classroom is a struggle for many of my students. We need to praise students' efforts. We grow and develop through: effort and persistence, challenging ourselves, learning from mistakes, using appropriate strategies and seeking new strategies when needed. Some students struggle despite effort and need help using strategies, others who believe that effort pays off but do not value what they are learning. We can have students reflect on the learning strategies that they are using and to encourage new approaches. It is also helpful to encourage challenge as a necessary part of learning so students feel more comfortable with the frustration that comes with struggle. Students also need support by helping them find value and relevance in what they are learning, so they are motivated and willing to put forth effort. Purpose, value, and relevance are particularly important in the online/hybrid environments. Sense of belonging is more challenging when students are turning off the camera. The only person we can change is ourselves in the end, so we must continue to be positive in our approach to education, especially now.

3.6 Types of Content

The contents of the class certainly has a major impact on the class design and the teaching model. Purely theoretical classes lend themselves more easily to an online teaching model, but even than there are considerations to be made. A Calculus class is an example of teaching a topic that is easier to do as an online and asynchronous class with recorded class sessions, lots of online practices and resources available, and where even helping a student going through a failed exercise can be done online. Classes that benefit from student discussions, like for example Computer Ethics, are still possible online but with the caveat that some students will be less active in the discussion (but most likely they would have been less active in a face-to-face discussion session too). On the other extreme are classes that require physical presence for instance due to the use of expensive mechanical tooling and/or the need to the instructor to observe the work as is happens and be able to direct the process (e.g. master-apprentice scenarios). These classes may still be done in a hybrid fashion where the theoretical part is done online while lab sessions are done on site.

3.7 Working with Students

The above models were helpful to me when structuring my writing for the patterns for online education. This said, it is not meant as a deep dive into human psychology, and although I am an experienced educator and have worked with students for many years, I am by no means a psychologist. I do spend time exploring and researching

educational topics, and I would urge the interested reader to do the same to build their models and adopt techniques that work for their own context.

4. PATTERNS FOR ONLINE EDUCATION

"Patterns and Pattern Languages are ways to describe best practices, good designs, and capture experience in a way that it is possible for others to reuse this experience." --- Hillside.net

The written pattern can provide reusable knowledge in many domains. Take for instance a pattern for knitting socks – on the surface it may seem prescriptive telling you the number of stiches and how high to knit. But it embeds the fundamental knowledge to knit any socks: how to get started, how to create the heel, how to make the toe, etc. As soon as you have experience you can apply this knowledge to make socks of any size and color of thin wool or thicker wool or cotton. You may start making your own improvements like continuing the ribs on the top to make the size more flexible. At this point your pattern is no longer a piece of writing handed to you by the author, but fundamental knowledge enabling you to create.

At this point, the patterns for online education presented here are based on my personal experience, my conversations and interactions with my colleagues, and my reading (e.g. my "research"). I hope to continue collecting patterns in this area through pattern mining workshops and other activities to learn from a larger group of educators. At a later time this may turn into a pattern language with recognized pattern sequences and better understood connections between the individual patterns. For now, I am handling this as a collection and in documenting what I have gathered I hope it can be useful to other educators.

I have deliberately chosen to present the patterns in a short form influenced by the Iba lab style (ref). There are two reasons for this: with a larger number of patterns the most important is to convey the totality of core ideas and concepts and for this each pattern cannot be too long, and the implementation of each pattern will depend on the way the college is operated and the actual capabilities of their LMS system and other chosen technologies reducing the value of explaining implementation details. Known uses are included only as references to supporting material.

My informal pattern mining activity that was performed over the last year through discussions with friends and colleagues eventually provided me with a number of drafted patterns that that I currently have grouped into the below categories. When and if the collection gets bigger this structure may change.

- Engagement and Interaction
  These patterns deal with topics related to learning types and human interactions and motivation.

- Course design
  These patterns take into account various teaching models as well as how to make class attractive to students with different learning styles.

- Security
  These patterns deal with the need to know the identity of who you are teaching and especially who is actually taking an exam. Unfortunately the online models for education have problems around identity fraud.

- Technology
  These patterns provide insights in how tooling can benefit the online model from absolute necessities to nice to have features.

A map of the patterns and their interactions is shown in figure 2. I have indicated connections between some of the patterns where this was found during the patterns writing. For now I am just showing some type of support

from one pattern to another. I expect to find mor connections and understand them better as I continue the work on this collection.

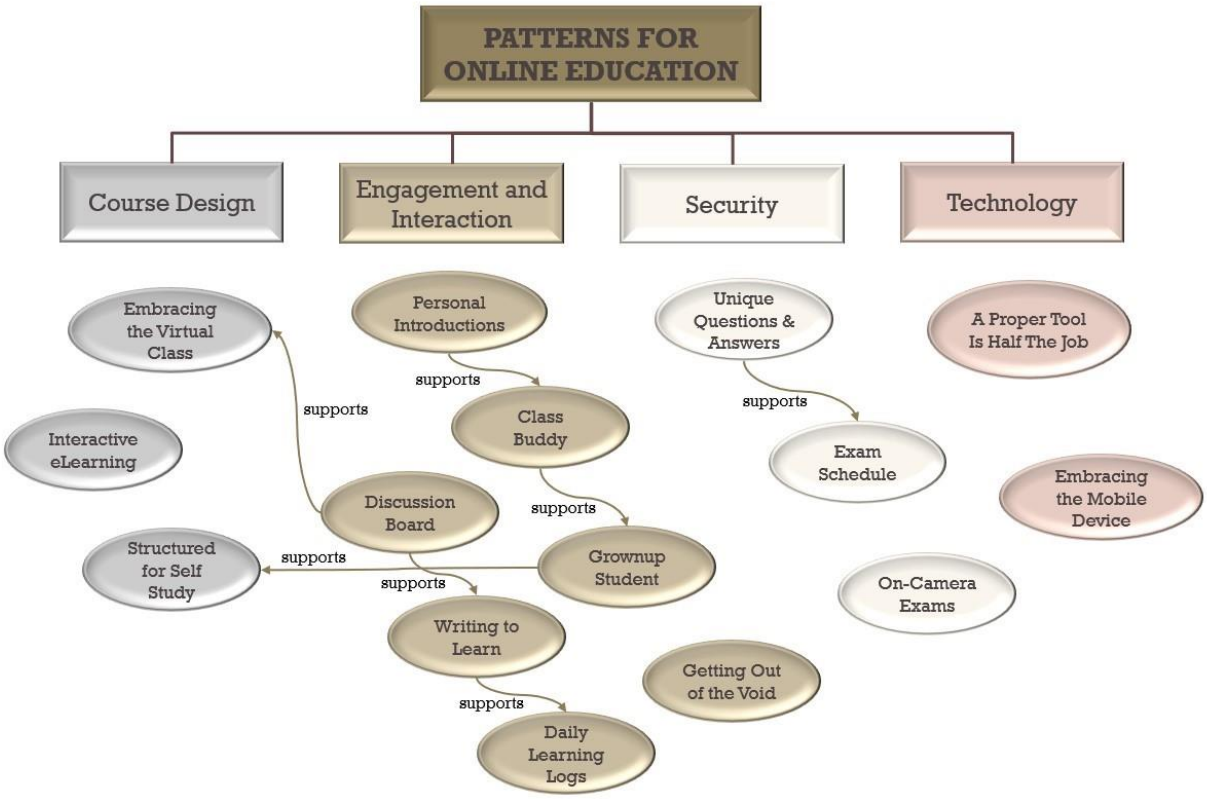

Figure 2: Patterns Map

4.1 Patterns for Engagement and Interaction

The patterns for engagement and interaction focus on creating a community of trust within the virtual class to enable students to collaborate with each other, to promote students active participation in a class, and to create a context inducive to the learning process.

Personal Introductions

"Well-thought-out introductions are the key to establishing a sense of presence in your online classroom. Doing that, it turns out, can lead to all kinds of benefits, like the amount of communication you have with your peers, your satisfaction with the course, and even how much you feel you are learning."

--- Linnea Sudduth, Colorado State University

You want to engage students and create a class community from the start of the semester.

The students are meeting online in the class but most likely they do not know each other. They will get a higher benefit from the class if they can interact with each other. They also need to interact with the educator and quickly build up a trust relationship.

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Therefore start the class with doing a personal introduction of the educator and of each student. For the educator you can be more detailed, by not only providing some background about yourself and a photo or video, but also your perspective on each topic, and information about your availability for one-to-one communication with students — via email, chat, office hours (face-to-face or virtual). For the students they should share some of their motivations for taking the class, their major, and something about their communication style, if they are in a different time zone than the college, and if possible something funny or interesting. Peer learning and sense of community formed through discussions is very valuable so during the first week of the class you can have all students participate in an introductory discussion. Some students are shy and may not be comfortable with sharing so this should be held in a light tone and be reasonably flexible about the content and participation.

References to known uses:
https://www.uvm.edu/ctl/designing-and-teaching-courses/getting-started-page-for-online-courses/
https://sites.google.com/site/diversitychangemanagement/Home/introduction-and-welcome-email
https://vpaa.unt.edu/sites/default/files/documents/page/2021/online_ice-breaking_examples.pdf

Class Buddy

"A buddy system helps to promote friendship, better support of coursework, behavioral and social needs, and can foster a greater sense of belonging and a more inclusive school community."

--- Wikipedia

You want to enable every student to communicate with other students.

Some classes have team work assignments and students need to find partners to work with. This is harder for online classes where the students don't get to hang out and meet in the classroom. Knowing some fellow students can enable informal study groups, and some students find it easier to ask questions to other students than to the teacher. Students who are shy find it harder to reach out to fellow students.

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Therefore create a buddy system from the start of the semester to seed student to student interaction. The buddy system could be one to one or smaller groups of 3-4 people. It may be based on the ***Personal Introductions*** matching up people based on similar interests, experience and/or geographical locations and time zones.

References to known uses:
Using the Buddy System in Online Teaching https://www.youtube.com/watch?v=S7pFt2FarL0
https://files.eric.ed.gov/fulltext/EJ1053718.pdf
http://www.irrodl.org/index.php/irrodl/article/view/2179/3690

Discussion Board

A good discussion increases the dimensions of everyone who takes part.
--- Randolph Bourne, American Writer

You want to engage students so that they can learn better about the course topics.

The discussion board feature is common in LMS tooling. By participating in discussions around course topics the students can improve their understanding of the various concepts they need to learn, while also strengthening the bonding between the students in the class.

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Therefore encourage the use of the discussion board and make sure the students know that using it counts towards class participation. Some students will take to using it easily, and it can be a good alternative for students who are less comfortable talking in class. Be an active participant to stimulate good discussions and do not forget to use humor to engage. If you still feel that the uptake of the discussion board is too slow you can embed it into the learning by introducing contents there that are needed for upcoming assignments, and by actively using the discussion board during the online class sessions. If students send you questions you can encourage them to post it on the discussion board and then engage on the topic there actively pulling in more students in a dialogue.

References to known uses: https://www.emergingedtech.com/2019/05/5-ways-to-improve-online-discussion-boards/
https://www.codlearningtech.org/2020/07/06/discussion-board-best-practices/
https://www.d.umn.edu/~hrallis/professional/presentations/cotfsp06/indiv_tools/blackbdscreenshot.html

Writing to Learn

"Writing organizes and clarifies out thoughts. Writing is how we think out way into a subject and make it out own. Writing enables us to find out what we know – and what we don't know – about whatever we 're trying to learn."
--- William Knowlton Zinsser, Author

You want to engage students and help them process the scope of the daily classes.

Students may have trouble developing ideas fluently. Writing about a topic helps them to organize their knowledge. To write one needs to have a level of clarity on the subject, and it will drive you to explore and analyze. This is especially important when taking an online class where you need to engage with the course material more independently and there is no one directly observing your learning. Writing is also shown to improve the ability to remember (add ref). In most college classes the students will have to produce written materials, either as homework, reports, or as part of tests. Gaining experience with writing throughout the class is important for their performance and grades.

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Therefore make the students create a written item during each class and share it with the class. The writing can be formal or informal but must be short. It is not meant to be extensive or take a lot of time, it is not an essay or report, and it can be processed/shared at the start of class within a few minutes. You may ask the students to post on a ***Discussion Board*** to make it easy and fast to share with everyone in class. When the students are asked to convey the main ideas of the lesson the answers vary widely. Even with a class of 24 students they do not repeat the same thoughts as this shows the students originality. Discussing a few of the writings in the class helps everyone getting better clarity of the concepts being discussed. As the class trust is getting more established you can tweak the writing assignments to allow for interesting viewpoints, emotions, and humor.

Some students feel uncomfortable sharing. This needs to be respected but you can nudge them and over time most will participate. The writing is not graded, but participation in the discussions may influence the grade.

References to known uses: https://www.brown.edu/sheridan/teaching-learning-resources/teaching-resources/classroom-practices/writing-learntimes-change
https://www.slideshare.net/ddesroches/writingtolearnwithtech-mac
https://www.umt.edu/writing-center/docs/What%20is%20Writing%20to%20Learn.pdf

Daily Learning Logs

"Use the learning log at intervals to stop and really think back on the things you have discovered." --- Faye Hall, Open Colleges of the Arts

You want to help the students interact with the class contents.

In a virtual setting it is harder for the teacher to know what the students are gaining from the class, especially for students who are not active verbally during the class sessions. For students the amount of materials can be overwhelming, and unless they process it gradually during the semester they can easily feel lost and give up on the class.

***

Therefore ask the students to run a daily log to create a low-profile ongoing engagement based on questions like:

1. List the main concept(s) that were discussed today.
2. Choose one of these concepts and explain what skills are needed to understand and/or apply it.
3. Give a brief explanation of the concept.
4. How did you participate in class today?
5. What emotions did you feel today
6. Additional Comments

For the student, keeping a log where they reflect on what they have learned and where they can organize and summarize the course contents is an exercise in ***Writing to Learn*** that shows good results in maturing and taking ownership of the knowledge. By sharing the log with the teacher helps the educator in understanding if the course content is understood and if something needs to be elaborated on in the classes. Even more it allows the teacher to gauge the motivation of the students, as it helps them not only reflect on the essence of the contents but the log provides them with a way to express their feelings and to know that the educator is there for them.

References to known uses:
https://www.niu.edu/citl/resources/guides/instructional-guide/reflective-journals-and-learning-logs.shtml
https://bigideas4littlescholars.com/learning-logs-and-writing-to-learn-kids-brains-benefit/
https://www.ucd.ie/teaching/t4media/learning_journals_logs.pdf

Getting Out of the Void

"There are lots of valid reasons for students to keep their cameras off during class…but all the cameras off can sometimes make it feel like you're standing at the edge of the wing of a space ship looking out into the endless void of space. Some teachers lose their chill in that moment." *--- Zachary Kuhn, English Teacher*

You want to engage with the students thought the virtual tooling.

It can be very hard to interact with an online class. Many students sign in to the class session and do not do anything after that. They do not turn on the microphone or the camera. This makes teaching harder. You don't know if they are tuned in, if the teaching is understood, or if they walked away,

***

Therefore design the sessions to have parts with verbal interaction, and share with your students the benefits of the teacher having visual contact with the students. Be honest about your own need for non-verbal feedback and how difficult it is to teach to a black screen. The Zoom, CISCO WebEx, and Blackboard tools offers built it collaboration functionality to simulate the interaction in the classroom. In order for this to work effectively every student should have the camera and microphone on, but you will need to accept that some students are reluctant to do so and that they may be in environments (like at home with their family present) where the use of two-way media is not feasible. Utilizing the break out rooms creates a different atmosphere causing students to turn on microphones and cameras as they know the teacher is not in the room. It is also a smaller setting. Some students are fearful when speaking in a full class. Including teacher free parts can help make students more comfortable with having their cameras and microphones on. For the teacher to no longer feel they are talking to the void you need some engaged students, not the full class.

References to known uses: https://www.unconditional-teaching.com/index.php?pg=teaching_into_the_void-musings-on-online-teaching-during-apandemic
https://www.winchesterstar.com/winchester_star/op-ed-zoom-classes-felt-like-teaching-into-a-void---until-itold/article_5aec41b3-e206-5c0b-b666-ed85df5852a6.html
https://southblueprint.com/23416/features/teaching-into-the-zoom-void-teachers-struggle-with-students-lack-ofengagement/

Grown Up Student

No matter how charismatic and engaging we are, how much technology we leverage, how many classes we flip or how many pallets of rubrics we deploy, in the end, it's still the students who have to do the learning. We may be able to make it easier to learn, cheaper to learn or more fun to learn, but students will still have to do the work."

--- Eric Gilbert, Arkansas State University

You have students who are falling behind and not engaging with you or the class.

There may be several reasons why a student is not engaged. It can be mundane reasons like taking on too many classes or juggling work and education in parallel. It can be technical problems with connectivity. But is can also be personal issues like poor confidence and social anxiety. To help the student you need to be able to investigate the problem. Unless you are a trained professional you need to be careful with how you intervene.

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Therefore make it clear at the beginning of the semester that you will treat your students as grownups responsible for their own life, and that your role is that of a educator and not a parent. If students are falling behind, reach out and do what is in your means to understand the problem. Get their motivation for taking the class and discuss with them what they what they need to fully participate. Maybe they need some extra help, maybe the personal attention is enough, maybe a change of ***Class Buddy***? But also keep in mind that there will be students that you cannot help. You need to accept that some students will fail. Maybe they will realize that they need to act as a grownup and this was a wakeup call. Or they were not ready for this class or online learning anyway and nothing you can do will resolve that. If you suspect or know that the student needs help for mental issues you can alert the college administration and show compassion with the student, but bottom line you need to free yourself from any guilt.

References to known uses: https://repository.brynmawr.edu/cgi/viewcontent.cgi?article=1010&context=edu_pubs
https://www.edutopia.org/article/putting-students-charge-their-learning
https://www.insidehighered.com/advice/2018/10/02/why-students-should-take-more-lead-their-own-learning-opinion

4.2 Patterns for Course Design

The patterns for course design deal with creating classes that are tailored to online teaching and interactions.

Embracing the Virtual Class

"In times where small instructor-led classrooms tend to be the exception, electronic learning solutions can offer more collaboration and interaction with experts and peers, as well as a higher success rate than the live alternative."

--- Keith Bachman, Corporate eLearning Executive

You are designing a new class to be taught online.

It may feel very challenging to create your first online class. Suddenly you are not face to face with students while you are teaching and there is less opportunity to adjust you style and your contents on the fly based on the body language of your students. How will you know if they understand and you can move on to new topics?

***

Therefore, take advantage of the online medium when creating a class rather than trying to mimic the face to face classes from the past. Interaction with students are now asynchronous so give them a way to study, communicate, and ask questions at any time – this way they can engage when they have time, and you can build on the student community to provide feedback and engage through ***Discussion Boards*** and other tools like Miro or Mural where you can run interactive activities in a fun way. You will be able to judge student learning through their postings, but you will have to learn how to live with the fact that it is no longer a real-time feedback.

References to known uses: https://hbsp.harvard.edu/inspiring-minds/a-4-step-framework-for-post-pandemic-course-design/?ab=top_nav http://dltoolkit.mit.edu/online-course-design-guide/ https://spscoursedesign.commons.gc.cuny.edu/introduction-to-design-and-development/

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Structured for Self Study

Outlining your online course means dividing the content into digestible chunks/modules, which helps students navigate the course through a consistent structure. The modules can be organized by content topics, units/lessons, or a time frame (daily, weekly, bi-weekly, etc.). Usually a module includes overviews, readings, lectures, discussions, and other relevant activities.”

--- University Of Illinois Urbana-Champaign, Center For Innovation In Teaching & Learning

You are building up the contents on an online class.

In an online teaching context your students will interact with the teaching materials not only during the class but asynchronously with the lectures. This is creating new demands on the course materials that are now more prominent in the learning rather than supporting the interactive sessions.

***

The foundation of success is to have a very clear structure with informative headings to support the content overview and navigation. Students who chose to be less involved need to know what your fundamental contents are, but for the ***Grown Up Student*** there can be interesting additions to explore. You can incorporate alternative paths and parts to provide the students with interesting options, and pull in from publicly available lectures and other resources to expand and support your core material. Videos, photos, and eBooks all help to improve the lessons. It helps tailor the education and make the classes more dynamic while also being cost effective.

References to known uses: https://news.wfu.edu/2011/04/29/successful-learning-engaged-students-it%e2%80%99s-no-longer-a-textbook-case/ https://www.insidehighered.com/digital-learning/advice/2017/03/15/4-expert-strategies-designing-online-course https://corp.kaltura.com/blog/designing-effective-online-courses/

Interactive eLearning

“Think out of the box and create a learning experience where the learner can interact with the content and their brains.”

--- Rosalie Ledda Valdez

You are teaching an online class and are looking for additional resources and support.

Creating a full course online for your students is time consuming and requires reviews and testing to be completed. When teaching standard classes like Calculus you should not need to create this material from scratch, but you may still want to add your own materials to elaborate or stretch the standards contents.

***

Therefore, evaluate the use of interactive learning systems that fit your classes and allow you to add contents as needed or desired. There are several tools on the market, for instance ZyBooks for STEM classes or Codio for Computer Science. These tools offer web-native contents where interactive activities and labs are integrated into the contents. Some tools are costly but have reasonable pricing for the students. If possible you can get you college to support the purchase, or maybe the college already is using this type of tooling for other classes.

References to known uses: https://www.zybooks.com/why-zybooks/ https://www.codio.com/

https://www.buzzmath.com/en-us/learn-more/

4.3 Patterns for Secure Exams

Creating exams that can be administered online require serious considerations to avoid or at least reduce the possibilities of cheating. Exams are a way to measure a person's mastering of a defined content, and the documented exam results are important to most students in their job seeking. The overall problem for these patterns are the question: How do you make sure that the online exam results for a student truly reflects the knowledge and skills of that student? When testing a student the outcome and the grades given are to reflect that student and not be a result of the student getting assistance from others or finding the answers to the exam questions online. When combined, the patterns in this chapter make it difficult to cheat on exams. The combination of tricks and techniques create an experience where the "path of least resistance" is to learn the material and take the exam as it should be done.

Unique Questions and Answers

"Moodle allows instructors to reorder questions, randomize questions, and shuffle question order."

--- Center for Teaching and Learning, UMassAmherst

You are designing an exam that will be held online.

Since your students are accessing the exam online it is difficult to stop the students from communicating for instance through their phones or other devices during the exam, and to compare answers and help each other to complete the questions.

***

Therefore, ensure that each exam give to a class of students has a unique set of questions and answers so that none of the exams given are identical. This way you will make it difficult for students to collaborate during the exam. Here are some specific actions you can take:

- Scramble the questions and answers
- Pull from a larger set of possible questions of similar difficulty
- Change values, change names of variables, anything to make sure your question is unique
- Avoid multiple choice answers but require a formulated writing from the student
- Give small exercises where you have to show work like apply a calculated formula
- Require a short answer where the students must fill in multiple blanks
- Use personal information as part of the answer to make it unique
- Use opinion type answers on a scale and possibly with adding a reason for the answer
- Include a short written essay (at least for the final exam)
- Avoid using questions from "test banks" but create your own
- If using questions from "test banks" then do some modifications to make them unique
- Do a search on questions to make sure you cannot find the answers online
- Look for copied answers in the completed exam (from other students or from online)

The best results in respect to uniqueness comes when you combine several of these actions for your exam. Having the students formulating textual answers makes it easier for the teacher to see if students have identical answers. Of course these tests come with an additional effort in grading as it is not possible to do automated grading (unless you have a great AI solution that is – in the future that may be the reality).

References to known uses: https://www.umass.edu/ctl/how-do-i-design-online-exams

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https://cft.vanderbilt.edu/online-exams/
http://www.clemson.edu/online/documents/best-practices/online_test

On-Camera Exams

Proctoring solutions enable administrators of online assessments to create a more secure testing environment by deterring and preventing instances of academic dishonesty. Test administrators use proctoring software to verify test takers' identity, lock down web browsers, and monitor examinee behavior during the test. These platforms make it possible for test takers to complete exams at home using their own computers instead of at an in-person testing center."

--- G2.com

You are managing an exam held online.

In a classroom setting you have visual “control” of the students and can make sure they are not getting the answers to exams from each other or from the internet. But when you run the exams online you don't know if the student is really the one taking the exam or if they are using an “open” book or even contacting a friend for help.

***

Therefore, use a camera during the test to see the actual person taking the test. This does require the student to have a web cam and installed software, and it may feel intrusive especially if the student is doing the exam from home. Your college may provide other options for students who are in the vicinity of suitable locations. But also remember that taking this exam is a conscious choice by the student, and in a classroom setting the students are also watched during the exam. The college should be clear on this expectation from the start of the class to avoid it coming as a surprise. There is concern about the privacy and around some of the tooling for this way of monitoring the students [Da2020].

References to known uses: https://www.erasmusmagazine.nl/en/2020/09/10/eur-considers-using-second-camera-in-proctored-online-exams/ https://www.goodfirms.co/blog/best-free-open-source-exam-software-solutions https://www.insidehighered.com/digital-learning/article/2017/05/10/online-exam-proctoring-catches-cheaters-raisesconcerns

Exam Schedule

“Provide just enough time that a student who knows the information would have the appropriate amount of time to be successful on the exam, and not too much time for students who have not prepared for the exam to search for the answers."
--- Stephanie Smith Budhai, associate professor of education at Neumann University

You are planning the execution of an online exam.

When scheduling an exam you want to make is as flexible as possible for your students. But too much flexibility unfortunately opens for challenges to fair play from the students. A longer time slot makes it easier to get external help and to compare answers with other students. Variable time slots (e.g. letting the students start the test at different times) opens up for students who have finished the test to help classmates who are taking the test later.

***

Therefore, schedule a test with reasonable time (enough but not more) to complete but stick to one time window even if this is inconvenient for some students. Should you need to provide multiple test windows, use ***Unique Questions and Answers*** and do not provide answers to the test questions or the test results for any students before all students have finished their test. You should also not allow for a test to be repeated due to technical problems (this seems to happen too often indicating it is a chance to retake a test), but make sure the testing tool will save the progress and you can let a student back in to complete the rest of the test but not to reopen the answers already committed. This also means you may need to design the test in a way that blocks back-tracking.

References to known uses: https://www.k-state.edu/keepteaching/online-exams.html
https://www.facultyfocus.com/articles/educational-assessment/fourteen-simple-strategies-to-reduce-cheating-on-onlineexaminations/
https://www2.palomar.edu/pages/teachanywhere/strategies-to-reduce-cheating-in-online-courses/

4.4 Patterns for Technology

Teaching in a virtual setting requires some level of digital technology to enable communication and access to the learning material. This tooling is commonly referred to as the Learning Management System (LMS). Additional tools can be helpful for collaboration (Miro, Mural etc.), for planning (Trello) and for checking in with your students in a friendly way (SurveyMonkey). The patterns in this section are helpful when choosing and utilizing these tools.

A Proper Tool Is Half The Job Done

"Give me six hours to chop down a tree and I will use the first four to sharpen the axe."
--- Abraham Lincoln

You are an college level educator doing most or all of your teaching online.

The digital tools you use for your online classes will have a big impact on the quality of your classes. They are the foundation of the daily work for both you and your students. There are many tools on the market with overlapping or similar functionality, but there is also significant differences in usability and performance of these tools. The tools may have many features that you do not need that make them more complex to use.

***

Therefore, select digital tooling that supports the basic needs of both the teacher and the students in a way that provides a positive user experience for both. It is good if the LMS system supports low end/low cost tools like Chromebook or even cell phones. The business logic should run on the server side while the students only needs the browser and credentials. Additional tools can either be provided by the college together with the LMS system, or you can use free tools or tools that have good discounts for students. The more you learn about utilizing the tools you selected (or that were selected by your college), the better you can support your students and get the most out of the online experience. If you and/or your students have limited bandwidth you need to avoid the need to use cameras and features that are data intensive. An LMS system that incorporates most of your needs (online materials, scheduling and running lectures, student assignments, test management, and some level of collaboration) may provide the best support from an ecosystem perspective, while adding some external tooling for less critical tasks can spice up the course and make it less monotonous.

References to known uses: https://www.youtube.com/watch?v=hGD_lFIAcxA
https://pagely.com/blog/learning-management-systems-in-higher-education/

“

https://edtechmagazine.com/higher/article/2020/04/free-software-tools-colleges-can-use-online-learning

Embracing the Mobile Device

The students of the future will demand the learning support that is appropriate for their situation or context. Nothing more, nothing less. And they want it at the moment the need arises. Not sooner, not later. Mobile devices will be a key technology for providing that learning support.”

--- Dr. Marcus Specht, Professor of Advanced Learning Technologies, Open University of Netherlands

You are teaching an online class for a diverse group of students.

Not all of your students may have easy access to powerful computers. Some may even use their smartphone to access the course and join the lessons and the testing sessions.

***

Therefore, design your course to enable students to take the class using only their mobile device. This will create some limitations and you need to make sure that the LMS system and other tooling will support mobile devices. Your students will appreciate it as it provides them more flexibility and they can access the class at any time where they are able to use their phone, making it possible to join a lecture on the commuter train from work or while visiting grandparents with no internet.

References to known uses: https://www.educationcorner.com/cell-phones-learning-tools.html
https://www.edutopia.org/article/how-phones-can-facilitate-distance-learning
https://www.bestcollegesonline.org/faq/can-i-use-a-mobile-device-for-taking-an-online-college-class/

5. CONCLUSION

The patterns in this paper are a result of my own and my colleagues learning over the last 3 semesters being plunged head first into making online teaching a reality for all our classes. We discussed experiences that worked especially well in an online learning course and how to use them effectively, and I hope and believe that other instructors can use this material to improve engagement and learning for students. The patterns will continue to evolve. I feel I am still in the middle of a journey, learning more for every new class and every new semester.

Based on the information presented in this study I am hopeful that we will design better courses, blending the best of both pre and post pandemic pedagogy. Through the development of patterns, I tried to examine which ways online delivery improve course experiences, and which do not. What works better asynchronous versus synchronous, online versus in person, discussion versus lecture based, and how to blend them into a course that maximizes engagement and learning in a course.

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https://library.educause.edu/resources/2012/2/7-things-you-should-know-about-flipped-classrooms [Edu2020]
ELI 2020. *7 Things You Should Know About the HyFlex Course Model*, Educause.
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