So, H. J. et al. (Eds.) (2020). Proceedings of the 28th International Conference on Computers in Education.
Asia-Pacific Society for Computers in Education

Overcoming Transactional Distance when Conducting Online Classes on Programming for Business Students: A COVID-19 Experience

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Abstract: Studies have shown that transactional distance negatively impacts student learning. In the context of learning, distance pertains to the geographic, pedagogical, and psychological gap between instructors and students. This perception of distance is magnified in online learning because instructors and students do not meet face to face. The gaps involve not only the geographic aspect. Another gap is pedagogical, which depends on the online course's design and structure flexibility and how these align with the students' level of autonomy. Still, another gap is psychological, which relates to how students perceive how much the teacher is accessible or disengaged (level of dialogue) and with students' academic self-efficacy assessments. This paper describes how we could reduce the transactional distance between instructor and students by deliberately designing and conducting mostly asynchronous classes on programming for business students but with the right blend of non-lecture synchronous activities during tight lockdown due to COVID-19. We explain what used to work well before the pandemic where classes were onsite and face-to-face and what mechanisms we used to overcome the lockdown-related gaps. The course was held during Intersession and only had less than six weeks. Based on students' grades and general sentiments, the results were in line with expected learning outcomes, and miscellaneous feedback and comments from students were positive.

Keywords: asynchronous learning, online learning, blended learning, COVID-19, programming class, transactional distance, self-efficacy, scaffolding

1. Introduction

Transactional distance (Moore & Kearsley, 2011) refers to physical (especially in distance learning), pedagogical and psychological gaps, particularly between instructor and student and among students. Even in face-to-face class settings, there are pedagogical and psychological gaps between instructors and students, especially when instructors are perceived as disengaged (Clifford, 2018). This paper refers to any gaps, whether face-to-face or online, as transactional distance. Reference to the gaps is consistent with Clifford (2018), who shows that increased transactional distance and perceived instructor disinterest negatively affect student performance. Transactional distance involves three dimensions: structure, dialogue, and autonomy (Moore & Kearsley, 2011). Structure refers to the course elements such as learning objectives, content, and assessments. More structure tends to increase transactional distance because it diminishes the amount of flexibility for learners to chart their learning paths; however, less structure does not automatically mean reduced transactional distance, as will be shown later. Dialogue refers to communication between teachers and students. More dialogue tends to decrease transactional distance. Autonomy (or learner autonomy) refers to the extent that students' role in exercising self-management is that they get to decide what to learn, how to learn, and how much to learn. The level of autonomy required increases as transactional distance resulting from the given structure and dialogue increases. Since not all students will have the same level of autonomy or capacity for self-management, the right amounts of structure and dialogue need to influence the overall course design. One other thing to note is that low structure, low dialogue, and low autonomy lead to an increased transactional distance, as illustrated in Figure 1.

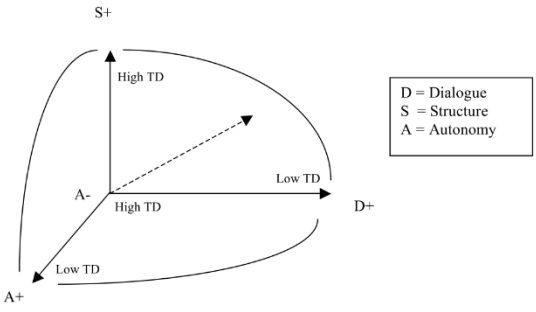

Figure 1. The Three dimensions of Transactional Distance (Shearer 2009)

1.1 Context

The school considers programming as an essential skill for business students. However, the students do not necessarily consider programming vital, especially when they graduate. Students' focus and interest would be on more demanding and perceivably more essential subjects. Therefore, students who are required to take this course may have apprehensions, thus aggravating existing psychological gaps. They may have beliefs that they have low academic self-efficacy—judgments of one's abilities given field with new, unpredictable, and stressful aspects (Bandura, 1977). Perceived self-efficacy is one of the largest predictors of academic performance (Eom, Wen, & Ashill, 2006; Downing, 2009; Hodges, 2008; DeTure, 2004). While on the surface, learner autonomy and academic self-efficacy seem related, there are not many studies on the relationship. Tilfarlioglu & Ciftci (2011) try to establish that relationship to academic success.

One year before the COVID-19 lockdowns, the researcher had positive results by 1) being available for consultations, and 2) relating topics to real-world applications and personal experiences. The methods and results align with discussions by Clifford (2018) on reducing transactional distance. With the COVID-19 pandemic, all interaction with students can only be through online channels, whether synchronously or asynchronously. Clifford (2018) discusses that asynchronous learning modes not accompanied by a significant interaction between instructors and students increase transactional distance. This paper describes the researcher's steps in designing and managing an online course with minimal transaction distance as a theoretical framework to maximize student learning during the pandemic.

1.2 Classroom dynamics before the pandemic

During face-to-face classes, students were free to ask questions and seek clarifications on the spot. The teacher then had opportunities to expound on the concepts on the spot. Teachers were also able to pause and ask students what they thought of certain things raised at particular moments. Students got to reflect on the answer. Students who shared their solutions got heard by others in the room. They were able to avoid misunderstanding about expectations on what had to be answered and submitted. Classmates discussed programming assignments and answers to exercises and sample tests together. They also shared possible solutions or insights to solving specific areas. This collaboration was done either in a physical setting in various places in the vicinity of the campus. This observation is consistent with the assertion that learning is a consequence of social interaction (Vygotski, 1997). As needed, students would ask for consultation hours with the teacher. During consultations, the teacher discussed thoroughly step-by-step solutions to challenging problems. For Final Projects based on real-world scenarios, student project groups also consulted with the teacher to discuss feasibility and direction. For most of the dynamics stated, there was a heavy reliance on interpersonal, face-to-face communication. Whether or not these dynamics can only be possible through face-to-face meetings or if there is an alternative way to provide most if not all benefits of collaborative learning, albeit forced by COVID-19, is what this paper will discuss.

1.3 Challenges brought about by COVID-19

The researcher notes informal conversations with a few business management majors of the John Gokongwei School of Management of the Ateneo de Manila University about their experiences with various online learning forms from the previous semester (when the COVID-19-related lockdowns started).The students cited several issues that fall under the different dimensions of transactional distance. There was a general sense of lack of structure. Some teachers dumped too much work (reading assignments, additional homework). Teachers and students had reduced communications. Students also had decreased interaction with each other. It was more challenging to ask questions and seek clarifications on various class matters. Items sent by students through email tend to take longer to answer.

In some cases, Internet access was either unavailable or unstable. There is also concern that group work cannot run smoothly. Studying with other classmates is more difficult due to the remote nature of the setup. The inability to learn together results in individuals having to take on more study load due to a lack of validation from peers on whether the concepts have been well-understood. Finally, there was a general feeling of lack of control. There was a constant fear of failing to submit requirements, especially for timed tests and assignments with tight deadlines due to poor Internet connectivity. Students also admitted not being good at time management, and the lack of structure made the feeling of lack of control worse. Studying from home was not conducive to learning as there were too many distractions. Overall, the sense of lack of control led to more stress. Distraction and confusion relate to negative academic performance (Rodrigo, Baker, & Nabos, 2010). With these concerns stated, students clamor for synchronous classes to cope with the need for structure and dialogue.

2. Course Design and Management

Transactional distance is the framework for discussing the overall course design and management for this particular online class in this study. The course design blends tutoring throughout—not just in the lecture videos and LMS text pages but also in assessments. The general course flow also relies heavily on the past experiences of students and scaffolding material. In learning, scaffolding is defined by Smith and Ragan (2004) as cognitive processing support that the instruction provides learners.

2.1 Course Structure

A module is a logical grouping of content and assessments in the LMS setup. The estimated number of learning hours per module is between 8-10 hours, and one module is approximately one week-long. The aim is to have between 45-60 learning hours (which includes watching videos, reading articles, practicing on exercises, answering assignments and tests, and working on the final project). For a programming course, this is not much time, so there had to be a way to incorporate continuous learning to spill over in areas outside of lecture and readings (content) through unconventional tricks such as embedding mini-tutorials in assessments.

The first part involving content design covers mostly the structural dimension of transactional distance. Topics span several video segments, each not exceeding 15 minutes. Cutting content into chunks is consistent with one of the strategies for the organization of content for online learners (Schutt, 2003). In place of scripts, outlines of talking points in conjunction with the desired end-state of the programming code already prepared and retyped during the video recording. The second part involves the learner autonomy dimension. Students decide how and when to take in the lessons. Program coding videos use Jupyter Notebooks for Python code, and the Atom text editor for all other text file related code illustrations (HTML and CSS). The teacher explains in the video the thought process while typing variables, statements, and function definitions. Any typing or syntax errors remain in the video to show the students how to fix things on the fly and minimize the number of questions involving syntax errors. Contextual descriptions of the videos' topics end up in Jupyter Notebooks as annotations or in the

Canvas LMS pages. While not directly addressed through content design, the dialogue dimension of transactional distance covers clarification and collaboration of the content and related activities (including assessments) through various communication channels and methods discussed in succeeding sections.

The course uses four (4) types of assessments:1) Assignments (similar to a take-home quiz), 2) End-of-Module Tests (covering 1-2 weeks or modules worth of content and are answered individually), 3) Major Tests (which look like mini-projects and are group work), and 4) A Final Project or Capstone. Assignments are intentionally more challenging than the End-of-Module and Major Tests. The thinking behind this is that assessments need to build on top of what the students already know. Having challenging assignments and exercises will prepare students to perform better in the tests. The first few assignments are simple, and it is easy to get a perfect score. The difficulty progresses throughout the course, and assignments coming in later have more real-world use cases. An example assignment which resembles a mini-project with medium complexity is Coffee Python, a prototype Point of Sale (POS) system in Python. End-of-Module Tests cover material for the previous module. These tests' completion times are intentionally short but fairly reasonable (between three to 24 hours). The intent is for each of these tests to be answerable within three to five hours, but the 24-hour window gives the student fewer chances to cite lack of time as a reason for not doing well. Major tests are more like mini-projects and are summative. They also are group work. Each group had 96 hours or four (4) days to complete the test. The tests also had embedded mini-tutorials (which also act like scaffolds) to teach students concepts not learned in any videos or pages. The embedding of scaffolding as mini-tutorials is consistent with the practices described in the work of Feng & Koedinger (2009).

2.2 Limitations, Technology Platforms, and New Capabilities

The primary Learning Management System (LMS) used for the course was the cloud-based Canvas Free for Teacher Use. The Canvas course pages have private, unlisted YouTube videos embedded together with supplementary text. Recording the videos with multiple video and audio sources was possible using Open Broadcast Software (OBS). The video sources were browser windows containing Jupyter Notebooks and screen projections from the iPad. Jupyter Notebooks was the primary programming environment due to the ability to add rich-text notes in the Markdown language before each program execution cell. On occasion, text editors were used, with the Atom text editor as the course's prescribed choice.

Whatever dynamics present in face-to-face classes lost with the pandemic lockdown translate into new modes of interaction. Not everything about the previous onsite class setup was ideal, in any case. COVID-19 hastened decisions to try different modes of learning. With structure, students can go through the course regardless of where they are, and they do not need to be within the vicinity of the school. Location independence benefits students from the provinces who could not go back within the university's vicinity. Students also have more leeway to submit assignments at their own pace. This flexibility also eliminates one source of stress, consistent with benefits cited by Clifford (2018). With the level of dialogue, the aim is for more in-depth discussion topics beyond the core concepts. Recorded video lectures allow students to replay portions they need to study until they understand the material, thus reducing the need for consultations with the teacher.

The live-coding style of videos looks more natural than merely showing pre-built code in presentation slides. The researcher uses social media channels for timely feedback and more substantial social and personal impact to be consistent with the assertion that learning is social (Vygotsky, 1997). Using Facebook effectively in education is consistent with Eger (2015) and Dougherty & Andercheck (2014). Discussion forums and group chats take the place of asking questions or sharing thoughts in-class. Announcements through LMS with backup reminders through FB Groups replace in-class or email announcements. Group chats enable collaborations that otherwise were only possible through meetups in physical places in and out of the campus. Consultations with the teacher on lessons or projects are possible through Google Meet or Zoom, with trivial questions and consultations quickly done through chat or email, unlike in the previous setup where students could only arrange for appointments for face-to-face meetings outside of class hours. Last, with learning autonomy, the

provision of Jupyter Notebooks produced from the video lecture recordings can be played around by the students.

2.3 Student Participants and Data Collection Methods

The class under study involved 28 students from the Bachelor of Science in Management Engineering Program from the John Gokongwei School of Management of the Ateneo de Manila University in the Philippines. The students had varying degrees of background in programming ranging from no experience to having taken courses but have forgotten the material since their Senior High School days. The study works with a sample representing the whole batch of BS Management Engineering Students at the Ateneo de Manila University as the population. The class formation cannot pass as random because students had a choice on which classes to join. Besides, unlike all other business management students, Management Engineering students have been qualified to join the program based on math aptitude.

Questions and comments on the topics, assignments, and assessments smoothly went through FB Messenger, Email, and the Canvas LMS Messaging facility. Grades recorded in Canvas LMS provide data on student course performance. Students frequently answered informal surveys that checked their pulse and sentiments through Facebook Messenger and Facebook Groups. Assessment scores and final grades are available through the LMS. One limitation of the study is that since everyone had to rush from face-to-face to online classes, there was very little time to plan for more rigorous data gathering techniques.

3. Results

Performance across the board at the end of the class was positive. Final grades were computed, with 24 out of 28 students getting A and 4 out of 28 getting B+. The complexity of the final projects was unexpected. Students were also able to do additional research on topics not covered in any of the lessons, and they were able to use the new knowledge in all final project submissions. None of the students were considered mediocre, and no one was ever in danger of failing the class.

Informal feedback from students was mostly positive as well. The feedback items can fall under the relevant transactional distance dimensions of structure, dialogue, and learner autonomy. In providing ample structure, the students enjoyed the sample code, which acted as scaffolding and mini-tutorials in assignments and the other assessments. These, together with relaxed deadlines, also made performing the assessments and overall learning experience more fun and less stressful despite the assessments being challenging. In addressing the perceived need for more dialogue, students found the ability to repeat videos, especially discussions on difficult examples. Even without actual conversations with the teacher, the videos flowed naturally (showed errors, discussed tips on finding patterns and building blocks), and covered many aspects of programming. Thus, repeating the videos minimized the clamor for consultations and synchronous classes.

Contrary to the general clamor to have more synchronous classes, the students of this class stated that there was no need for these since the teacher had been accessible through Messenger, and, at times, through Zoom for consultations. The students also agreed with the decision to allow the use of Facebook Groups and Messenger and they found the conversations and consultations valuable, especially during times when they felt stuck with specific concepts. The number of communication platforms was not an issue. Students realized they love programming because they saw their work fitting in broader real-world application settings. To promote learner autonomy, Relaxing deadlines for assignments made the learning experience more relaxed and fun, even if the teacher gives the most challenging problems. The scaffolds made it easier for students to research outside of class and encouraged exploration. Video lectures showing the teacher making mistakes (not edited out) encouraged students to try other scenarios to commit and fix errors.

4. Discussions

The outcomes of the implementation described in this paper are consistent with findings from previous work. The outcomes cut across the three dimensions related to transactional distance (Moore & Kearsley, 2011). All-in-all, the decision to address transactional distance are:

Ample structure, by providing scaffolding with ample flexibility throughout the course, record videos showing mistakes and correcting on the spot; More dialogue, by making the instructor available through chat and email and, occasionally through Zoom meetings, for consultations involving exercises, assessment tests, and the final project; and Ample learning autonomy by making deadlines less strict and making videos digestible enough to repeat repeatedly.

The combination of design choices for this online course made transactional distance negligible despite the lockdown-induced remote learning setup, as shown in the quality and complexity of final project outputs and the individual grades. More work, however, needs to be done, especially on the data gathering aspects. The next iteration of the course will include improvements based on the outcomes of this first run of the blended learning course.

Acknowledgements

The course that was designed and delivered, as well as the course that served as the basis for this paper, was made possible by the Ateneo de Manila University, the Ateneo's Department of Quantitative Methods and Information Technology, and its Chair, Joselito C. Olpoc, the John Gokongwei School of Management of the Ateneo, the Ateneo Center for Educational Development, the Ateneo de Manila Institute for the Science and Art of Learning and Teaching (Ateneo SALT), students, and research staff. Special thanks to Ma. Mercedes T. Rodrigo for the guidance and mentorship throughout the whole process until the writing of this paper. We thank them all for their cooperation and support.

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