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Designing a Multiple Submission Policy Supporting Mastery Learning for a Design Thinking Class in a Purely Online Learning Environment

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Abstract

Mastery learning is defined as an approach where students are equipped with complex skills required in the VUCA world instead of simple skills that only apply to traditional classrooms. One way to encourage mastery learning in the classroom is through repeated assessments, specifically formative ones. In this paper, we describe our experience in designing a multiple submission policy to support mastery learning for a design thinking class taught purely online amidst lockdowns due to COVID. The transition to online learning and today's context presented an opportunity to target mastery learning instead of traditional learning outcomes, which we achieved in two ways. First, we elevated the assessments' level on Bloom's taxonomy and encouraged iteration by providing feedback to guide metacognition. Second, we built creative confidence providing a safety net for graded assessments, which helped address fears of judgment and lack of control. In the process, we also overcame transactional distance to help promote self-efficacy, especially those with initially low grades. The policy was implemented with the aid of technology, which served as the medium for learning and dialogue. The use of technology in this study allowed for practices that were otherwise not implemented or even considered in previous trials of the class. The study resulted in positive feedback and improved quality of submissions from participants.

Keywords: Mastery Learning, Online Learning, COVID-19, Design Thinking, Bloom's Taxonomy, Metacognition, Self-Knowledge, Creative Confidence, Transactional Distance, Multiple Submissions

Introduction

Mastery learning is defined as an approach where students are equipped with complex skills required in the VUCA world instead of simple skills that only apply to traditional classrooms. The approach is founded on the philosophy that all students can learn well given the appropriate instructional conditions, which instructors can customize depending on their needs. In this way, students acquire basic intellectual competencies for learning at any stage in life. To apply the Learning for Mastery Strategy (LFM), instructors must define, plan, teach, and grade for mastery. In this paper, we focus on the planning stage where we developed feedback procedures alongside formative assessments and alternative instructional materials and procedures for students whose performance falls below the mastery standard (Block & Burns, 1976).

Mastery learning and design thinking have shared principles that prompted the implementation of the multiple submission policy:
1.   The mindset developed goes beyond the classroom and extends to all aspects of life, which called for a reevaluation of assessments and policies in the class.
2.   Both give focus to customizing or adjusting based on needs, which is not the norm in traditional classrooms where typically one size fits all.
3.   Both emphasize the need for feedback and iteration when the desired standard is not met.

Through the multiple submission policy, which embodies the similarities of mastery learning and design thinking, formative assessments became more aligned with the principles of the class itself.

This paper describes the researchers' steps in designing and implementing a multiple submission policy in an online design thinking class with mastery learning as the primary theoretical framework to improve the learning of students as measured by their submissions. The positive outcome is attributed to higher-level thinking and metacognition based on Bloom's taxonomy and creative confidence enabled by the perception of having a safety net for substandard grades. As a by-product of the increased dialogue between instructors and students, transactional distance was overcome to also promote positive learning outcomes especially from students with initially substandard grades.

Methods, Design, and Monitoring of the Class

This paper focuses on a class titled Creative Thinking and Innovation Management. All students of the John Gokongwei School of Management of the Ateneo de Manila University need to take this class in their curriculum regardless of the degree program they are pursuing.

1.   Online Setup

The course was hosted on the university's online learning management system, Canvas. The platform served as the main avenue for delivering course content and gathering submissions from students. Synchronous sessions were conducted on Zoom calls. Apart from Canvas and Zoom, other digital tools were used to enhance communication and engagement:
●   Students had the option to choose the messaging platform that would be most convenient and visible for them. For this class, students chose Facebook Messenger or Discord.

This is where instructors sent announcements, individually communicated with students, and conducted polls to have a better feel of the class.

● Padlet was used as an alternative to discussion boards at times to change the interface that the students engaged with. It was used to collect responses to both formal and informal discussions (e.g. getting to know activities). Padlet retains the commenting and reacting features of Canvas discussion boards but does not have the Speed Grader feature, where instructors can enter scores and comments on the students' assessments.

● Open Broadcaster Software (OBS) was used to record video feedback.

● PDF annotation tools were used as an alternative to the built-in Speed Grader function of Canvas.

2. Challenges of Online Learning

With the onset of the global pandemic, the university transitioned from face-to-face classes to a purely online learning setup. Online, students and instructors alike encountered several challenges on top of existing ones. Specifically, challenges related to the quality of students' submissions are outlined below:

● Unstable or unreliable internet connection is a potential source of delay for students going through the course. Cramming module content prior to an assessment provides no guarantee that students will still properly absorb the material.

● The workload of other courses affects how much time and effort students dedicate to this course. Students tend to distribute their time and effort to their courses depending on the workload given by instructors. Therefore, when other courses are more difficult or ask for more requirements compared to the course in the study, the quality of the students' learning within the course is affected.

● The students' living arrangements and conditions impact the students' performance in assessments. For example, a student tasked with responsibilities at home (e.g. ensuring their younger siblings attend classes or do school work offline, helping the family business) is likely to have less time to spend on their studies.

● After taking exams, students tend to question their scores more so compared to what their mistakes were. There is little motivation for them to correct their understanding of the concepts applied in the assessment since the focus or coverage of the next exams is not the same.

● Despite having several minor assessments (i.e. discussion boards and assignments) leading up to a major assessment (i.e. course project drafts and exams), there are students who find it challenging to apply their learnings or think more critically in major assessments. Typically, major assessments require a higher level of thinking that instructors do not test in minor assessments in the interest of guiding students through the levels of thinking.

● There are instances where students would parrot concepts from the course rather than share their own insights in fear of their insights being incorrect and getting deductions.

3. Course Design

The transition posed several challenges; however, it also served as an opportunity to reevaluate the courses being taught and make them even better than they were in the original face-to-face setting.

The course learning outcomes of the class are as follows:
1.   Justify the importance of creativity and innovation with a solid understanding of why they are necessary to survive in today's highly disruptive environment

2.	Appropriate the use of creativity and innovation tools, frameworks, models, and processes to various contexts including barriers, opportunities, and challenges
3.	Design ethical solutions that address real-world needs by mastering creativity and innovation principles
4.	Develop viable solutions by integrating creativity and innovation in a holistic way to achieve strategic organizational success or competitive advantage

The competency we aim to develop in the class is to design creative and innovative solutions and recommend strategies to solve organizational problems.

In the face-to-face learning setup, gauging the students' learning and providing feedback to them as often as possible was not emphasized. In a purely online learning set-up, however, more effort was required to interact with students and understand what they needed to master course concepts. Because online learning relies on the students' self-efficacy more compared to face-to-face learning, the instructors required more basis for guiding the students throughout the course. Following this, the instructors shifted to giving more formative assessments leading up to summative assessments as a feedback mechanism. The assessments of this class include the following:
●	Discussion boards, where students were prompted to deepen their critical thinking and argue based on their learnings from the class. This also served as an avenue for peer learning where they were encouraged to build on each other's outputs. Discussion boards were spread out across modules and served as quick checkpoints for both students and instructors. Compared to the other assessments in the class, these took the least effort while still giving instructors insight into how the students were progressing through the class.
●	Course project, where groups of students incubated startup ideas throughout the course. As their final output or culmination, students were asked to present their target market, problem statement, prototype, and business model canvas.
●	Progressive course project passes, where the project groups submitted components of their course project after completing each module. The components required in each progressive course project pass focused on the concepts covered in the module most recently covered by the students. These served as the most immediate avenue for students to create original output based on their learnings. This also helped instructors correct learning difficulties prior to the course project submission, which composed a significant percentage of their grades.
●	Weekly check-ins for the course project, where one week prior to submitting progressive course project passes, students presented their progress to the instructor and feedback would be given synchronously or asynchronously. These were conducted to ensure they were on the right track. They also served as an opportunity for the instructors and students to interact more and build rapport.

Through this combination of assessments, we aimed to better help students master creative thinking and innovation principles and understand and apply their learnings to the real-world setting, which both contribute to developing the competency set for the class. By becoming design thinking practitioners, the students will be able to successfully tackle challenges presented by the VUCA world by framing relevant problems, designing creative solutions, adapting quickly, and learning from the process (Krawchuk, 2019). The mindset developed by design thinking is not only applicable to school and career but to life in general as well (Razzouk & Shute, 2012).

Mastery Learning

According to Bloom, formative assessments are the instructors' key to reducing variations in students' achievements and ensuring they all learn well. Formative assessments give instructors insight into the students' learning, which helps them develop action points regarding class handling and individual student handling. On top of providing formative assessments to the class, Bloom argues that formative assessments should come hand in hand with feedback and corrective procedures to encourage mastery learning. In this way, instructors are able to diagnose individual learning difficulties and prescribe correctives when necessary. In a one-on-one setting, typically with tutors, the instructor points out the error in the student's work then explains and clarifies the error. In a classroom setting where there are many students assigned to one instructor, it is increasingly difficult to provide detailed feedback and individualized correctives per student (e.g. directing them to pages in the module or resources that elaborate on the concept, providing additional exercises). However, it is crucial to individualize correctives so students will be directed only to the concepts or skills that require more of their effort to master. Correctives, if timed well, prevent minor learning difficulties from accumulating and eventually becoming a major learning problem. Once correctives are given, Bloom recommends that students take a second formative assessment that covers the same concepts as the first. This allows instructors to (1) verify if the correctives were successful in helping students overcome their individual learning difficulties, and (2) offer students a second chance, which empowers them. In the interest of time and workload, students were no longer provided a second assessment and were instead allowed to redo the first assessment multiple times in the study. While this strategy focuses on low achievers, it may also be applied to high achievers. Students who performed well on the first assessment and do not require correctives may be given special enrichment or extension activities to broaden their learning experiences. This is self-directed and no longer requires a second formative assessment. This strategy, as visualized in Figure 1, results in students who are better set up for mastery of the learning outcomes of the course (Guskey, 2005). In this case, the learning outcomes refer to knowledge, skills, attitudes, and competences that remain relevant in the real world.
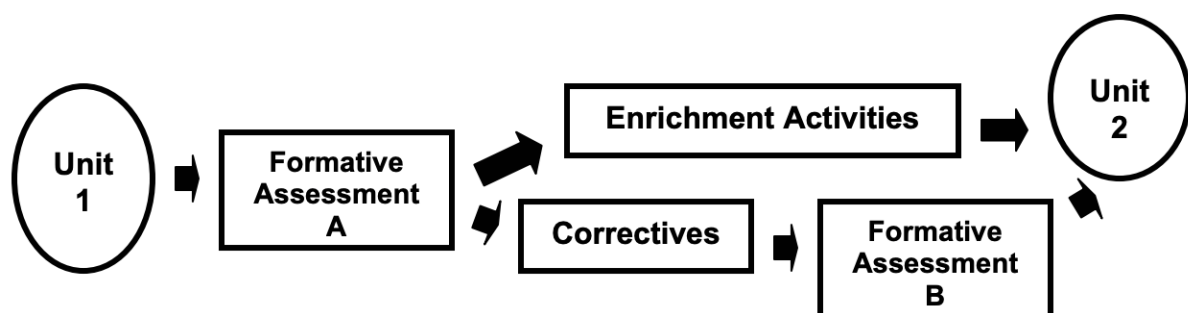

Figure 1. The Mastery Learning Instructional Process (Guskey, 2005)

Mastery learning results in two types of outcomes: cognitive and affective. Cognitive outcomes refer to the students' performance in the subject, which is typically measured by grades (Bloom & Carroll, 1971). Affective outcomes refer to the students' self-efficacy and confidence, which can positively impact the students' view of themselves and the world. When they believe they are equipped to cope with difficulties, they become less frustrated and more empowered to become an expert in the course concepts. This helps students to take on a lifelong learning mindset (Bloom, 1976).

Bloom's Taxonomy

Bloom's taxonomy proposes a hierarchy for designing learning such that students are guided towards higher-level thinking. The cumulative hierarchy is arranged from simple to complex and concrete to abstract, where the simpler categories are prerequisites to mastering the more complex or higher categories (Krathwohl, 2002). The categories are as follows:

Table 1. Structure of the Cognitive Process Dimension of the Revised Taxonomy
(Krathwohl, 2002)

Category	Definition	Associated Verbs
Remember	Retrieving relevant knowledge from long-term memory	Recognizing, recalling
Understand	Determining the meaning of instructional messages, including oral, written, and graphic communication	Interpreting, exemplifying, classifying, summarizing, inferring, comparing, explaining
Apply	Carrying out or using a procedure in a given situation	Executing, implementing
Analyze	Breaking material down into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose	Differentiating, organizing, attributing
Evaluate	Making judgments based on criteria and standards	Checking, critiquing
Create	Putting elements together to form a novel, coherent whole, or make an original product	Generating, planning, producing

In the revised taxonomy, metacognitive knowledge is put forth as a crucial part of students' learning. Metacognitive knowledge pertains to knowledge of the cognition process and self-awareness of one's own cognition. This type of knowledge includes:
1.   Strategic knowledge, which refers to the student's general knowledge of strategies for learning and thinking
2.   Knowledge about cognitive tasks, which refer to their knowledge of the effectiveness of the strategy and when and why to use them
3.   Self-knowledge, which refers to knowledge of the self in relation to their own cognitive and motivational components of performance

According to Carver (2017), a well-planned formative assessment includes a plan to provide feedback so that students can understand the demands of the assessment, evaluate their current performance, and identify action points to bridge the gap. The role of feedback in this policy involves self-knowledge, which was one of the goals of the multiple submission policy. When students are not self-aware of what they know and do not know, it is unlikely that they will exert effort to become more knowledgeable and master the concepts being taught. Therefore, it is imperative for instructors to help students make accurate assessments of their self-knowledge (Pintrich, 2002). One way of doing so is by providing timely feedback. Explaining

students' mistakes helps them construct a new understanding of the concepts based on their mistakes, guided by the instructors' explanations (Ahmad, 2020). In the course, most of the learning outcomes already pertain to the more complex categories of the taxonomy. For example, in their course project, they are asked to create a business concept that embodies what they have learned. Though this is already the highest level in the taxonomy, the multiple submission policy provides the metacognition aspect where students are made aware of the concepts they have yet to master, which enables them to reassess what they've learned and recreate their submission. This is parallel to the iterative nature of design thinking, where the correction of misunderstandings, acquisition of deeper knowledge, and improvement of output are guiding principles for solving problems.

Creative Confidence

Creative confidence is the ultimate competence developed by design thinking education and practice (Rauth et al., 2010, as cited by Bornilla & Amurao, 2020). It is defined as the natural ability to come up with new ideas and the course to try them out. This is less prominent in adults than children because as we grow older, socialize, and undergo formal education, we become more wary, cautious, and analytical. To reclaim our creative confidence, we must overcome our fears of the unknown, judgment, first steps, and lack of control. These four fears hold us back from practicing and strengthening our creative confidence. (Kelley & Kelley, 2012). The multiple submission policy specifically helps students overcome the fear of judgment and lack of control.

Fear of judgment is observed when students censor their own ideas and stick to "safe" ideas because they do not want to be judged by their peers or instructors (Kelley & Kelley, 2012). Academically, scores and grades are perceived as a form of judgment especially since it is the metric by which all students are evaluated. When grades are emphasized over feedback and learning, fear of judgment is exacerbated. Students end up avoiding difficult tasks, expending time and effort on getting to the correct answer, and even being scared of asking questions. When students are unable to overcome difficulties, they may conclude that it is because they lack ability, which they cannot do much about since it is an internal effect. This, in turn, damages their self-esteem. Formative assessments prove useful in addressing this when they become tools to communicate the mistakes and how to correct them, especially for low achievers (Black & William, 2010). The multiple submission policy takes advantage of assessments in the same manner and offers additional benefits:
●   Apart from communicating the mistakes to the student, they are allowed another opportunity to apply what they've learned from those mistakes, which the instructor may provide further feedback on. This may continue for as long as the student is willing to keep improving their outputs, which measure their learnings. The multiple submission policy enables feedback loops between instructor and student instead of one-way feedback provided by the typical single submission policy.
●   Because students know they can correct their mistakes, they can take more risks when answering assessments. This means they do not need to stick to "safe" ideas or censor themselves anymore.
●   The multiple submission policy helps cultivate a culture of success where students can feel the belief that they can achieve, whether the belief comes from the instructor or themselves.

Fear of lack of control is observed when students are unable to accept feedback constructively and let go of the gaps in their current knowledge (Kelley & Kelley, 2012). While students may not actively be resistant to feedback, more often than not, they do not dwell on the feedback on

an assessment. The assessments in a course may not always be comprehensive and could even cover mutually exclusive concepts. When the latter is the case, students have no motivation to pay attention to the feedback and correct their understanding of the concepts. In fact, they could negotiate for higher scores without doing so, which entails asserting why their submissions are correct. With a multiple submission policy in place, the following are made possible:

● Students are incentivized to pay attention to and act on the feedback if they wish to improve their grades (Caver, 2017). In effect, because they are given a second chance, they are given full control over their performance in the assessment even after having completed it the first time.

● The policy encourages a culture of feedback and normalizes mistakes. In a study done by Bohney et. al (2018), feedback was consistently given by peers and instructors throughout a writing process. This resulted in students writing more fearlessly, making mistakes freely, and learning from feedback as the mistakes were corrected.

By creating a safety net that helps students overcome their fears of judgment and lack of control, we bring them closer to developing the competence that design thinking and this course are meant to impart to the students, which is aligned with the outcomes of mastery learning.

Transactional Distance

Transactional distance (Moore & Kearsley, 2011) refers to physical (especially in distance learning), pedagogical and psychological gaps, particularly between instructor and student and among students. The larger the gap, the more negative the impact on learning. 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, as cited by Ilagan, 2020). 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 since it reduces the amount of flexibility for learners to determine their learning paths. Less structure, however, does not automatically mean reduced transactional distance. Dialogue refers to communication between instructors and students and students to students. More dialogue decreases transactional distance, which is good. Autonomy refers to the students' ability to do self-management and decide what to learn, how to learn, and how much to learn. When transactional distance increases, the required level of learner autonomy also increases. Since not all students will have the same level of capacity for self-management, the overall design of the course needs the right amount of structure and dialogue. One other thing to note is that low structure, low dialogue, and low autonomy lead to an increased transactional distance.

From the perspective of this paper, allowing multiple submissions and the rich feedback associated with each submission increases dialogue and therefore decreases transactional distance. This increases the students' self-efficacy, which promotes the affective outcomes of mastery learning

Multiple Submission Policy

For assessment to function formatively, the results have to be used to adjust teaching and learning; thus a significant aspect of any program will be the ways in which instructors make these adjustments (Black & William, 2010). Thus, allowing multiple submissions is a way for both instructors and students to benefit from feedback loops. Allowing multiple submissions

also enables students to accept and work with feedback that is not clouded by overtones about ability, competition, and comparison with others (Black & William, 2010). The instructors made a judgment on the amount of detail needed to nudge the student into resubmitting improved work.

In the face-to-face set-up, feedback was usually handwritten or typewritten. Students were also free to set appointments with the instructors to discuss the feedback on their outputs, but this was rarely utilized. When the university shifted to online learning, instructors and students became dependent on digital tools to facilitate and even improve the learning experience. Digital tools became indispensable to the implementation of the multiple submission policy. Submissions were coursed through Canvas, which stored all submissions, organized files, and simplified the grading process for instructors. After going through the submissions, instructors provided feedback in several ways:

● Synchronously, where the instructor hosted Zoom or Discord video calls with the students to discuss feedback and go through clarifications if necessary. This allowed for immediate feedback and quick communication if students had questions.

● Asynchronously, where the instructor either wrote down the comments or recorded themselves thinking aloud while evaluating the assessment. For the former strategy, the official learning management system of the university was used to upload comments. For the latter strategy, comments were recorded as mp4 files. The instructors recorded themselves as they used OBS to share the screen while annotating the assessment. The asynchronous mode of providing feedback allowed students to go through the feedback whenever it was convenient for them while also having the option to replay the recording if needed.

Apart from the end of the semester, students were not given deadlines for following up on their first submission. They were free to submit again as their time and workload would allow them to.

Results

The instances where students took the opportunity to resubmit can be classified into three types:
1. The student got a low score and intends on getting a higher score.
2. The student got a high score but wants to get an even higher score or the highest possible.
3. The student misunderstood the instructions and delivered an output that was not aligned with what was being asked for, resulting in a low score.

The first case composed most of the resubmissions and helped students bring their grades up to average or above-average scores. The second case was not as common but there were a few cases where students expressed their willingness to increase their mastery of the course concepts, thus resulting in higher grades. Because of the feedback loop, the instructors were able to challenge these students further with deeper discussions on the lessons. Without the policy, there may have been little incentive for them to challenge themselves more. The third case was also rarely observed but allowed instructors to pinpoint misleading or unclear instructions given to the class and correct them so that our mistakes do not impact the outcomes of the student. With traditional policies, the instructors' mistakes in communication would have produced outcomes that classified these students as mediocre or inferior. It is also worth noting that not all students took advantage of the policy, likely due to workload, time, or even personal constraints. Those who did submit multiple times usually submitted earlier than the deadline in anticipation of revisions, or garnered grades below their target or expected.

From informal feedback from students of the class, several students have stated that while they find the lessons difficult, allowing them to submit as many times as possible made them understand the topics a lot better. It was observed that students became more comfortable asking questions as they got used to receiving feedback on their work and having the opportunity to resubmit.

Specifically, for the asynchronous video recording feedback, there were students who explicitly stated that they appreciated it. For low achievers, it was observed that their understanding of the concept improved and it manifested in the difference between their initial and final grades for the resubmitted assessments.

The instructors encountered some challenges when implementing the practice:
● The instructors were not always able to provide feedback immediately after the students submitted their work. The delays limited the opportunities of students to submit work as often as they wanted.
● Deadlines for submission also limited the ability to submit as often as needed. For classes without deadlines, some students decided to start submissions towards the latter part of the term. In this scenario, however, students were fully aware they were in control over the grades they would receive.
● Lastly, assignments with less clear rubrics resulted in more feedback cycles than necessary. In some situations, the instructors felt exhausted after handling multiple submission cycles.

Multiple submission and feedback cycles helped not only the students but also the instructors. The characteristics of the submissions and feedback give a glimpse of what needed to be refined in the instructions. The rich feedback dialogue also helped instructors analyze the effectiveness of the learning content and method of delivery.

Conclusion

Opportunities to compare the performance of students on summative assessments such as group final projects between classes allowing multiple submissions and those that do not will help in quantifying the impact of the practice in learning outcomes. We foresee that this practice may lead to the fear of grade inflation, which may elicit objections from administrators, other instructors, and even classes under the same course where the policy was not implemented. It is also likely that instructors will struggle to customize this policy based on the needs of their own classes – timings between submissions, allowed number of submissions, changes in materials provided for submissions, and other technical details. Despite this, it remains our recommendation to explore the policy further because it will aid in continuous improvement of course content, method of delivery, and assessment policies. While other classes do not necessarily aim to build creative confidence, the multiple submission policy is still expected to have the same effect.

Acknowledgments

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