

# Bloom's Taxonomy Levels in Technology-Enhanced Flexible Learning During the Pandemic: Evidence from Philippine Higher Education Institutions

Dave E. Marcial, Aurielle Lisa Z. Maypa, Fredlie T. Bucog, Grace L. Apao

Silliman University, Philippines

## Abstract

The COVID-19 pandemic significantly transformed higher education, prompting a rapid shift to technology-enhanced flexible learning in the Philippines. This study examined the levels of thinking skills employed by educators during the pandemic using Bloom's Digital Taxonomy as an analytical framework. Data were drawn from participants of an open online course on technology-enhanced flexible learning, where teachers reflected on their instructional practices using the SAMR model and identified corresponding taxonomy levels in their course design and activities. Results revealed that the most frequently utilized level was *Creating* (59%), followed by *Applying* and *Analyzing*, while *Remembering* and *Understanding* were least represented. Chi-square analysis indicated that institutional region significantly influenced the level of taxonomy implemented ( $p < .05$ ). Furthermore, competencies related to instructional design, assessment, student interaction management, and data privacy were significantly associated with higher levels of thinking skills. Regression analysis showed that these competencies modestly predicted taxonomy level, with leadership and assessment emerging as significant predictors. The findings suggest that technology-enhanced flexible learning environments during the pandemic facilitated the integration of higher-order thinking skills, particularly at the creative level. However, variations across regional locations and competencies highlight the need for targeted faculty development and equitable access to resources. The study emphasizes the importance of aligning instructional design and assessment practices with higher-order cognitive processes to ensure meaningful learning in flexible and digitally mediated environments.

**Keywords:** COVID-19 pandemic, online learning, higher education, technology-enhanced flexible learning, Bloom's Taxonomy, higher-order thinking skills.

## Introduction

The COVID-19 pandemic, declared by the World Health Organization in March 2020, disrupted educational systems worldwide and forced higher education institutions (HEIs) to rapidly transition from traditional face-to-face instruction to online learning. In the Philippines, this shift was driven by the need to ensure continuity of education while safeguarding the health and safety of stakeholders (Joaquin et al., 2020; Lim et al., 2022). As a result, online learning became the primary mode of instructional delivery across both higher education and basic education sectors. Online learning in the

Philippine context has taken various forms, including asynchronous, synchronous, and bichronous modalities (Martin, 2021; Martin et al., 2020). Asynchronous learning allows students to access materials at their own pace without real-time interaction, while synchronous learning involves live, real-time sessions. Bichronous learning integrates both approaches, enabling flexibility while maintaining opportunities for interaction (see Figure 1). These modalities collectively shaped what is now referred to as the "new normal" in education.

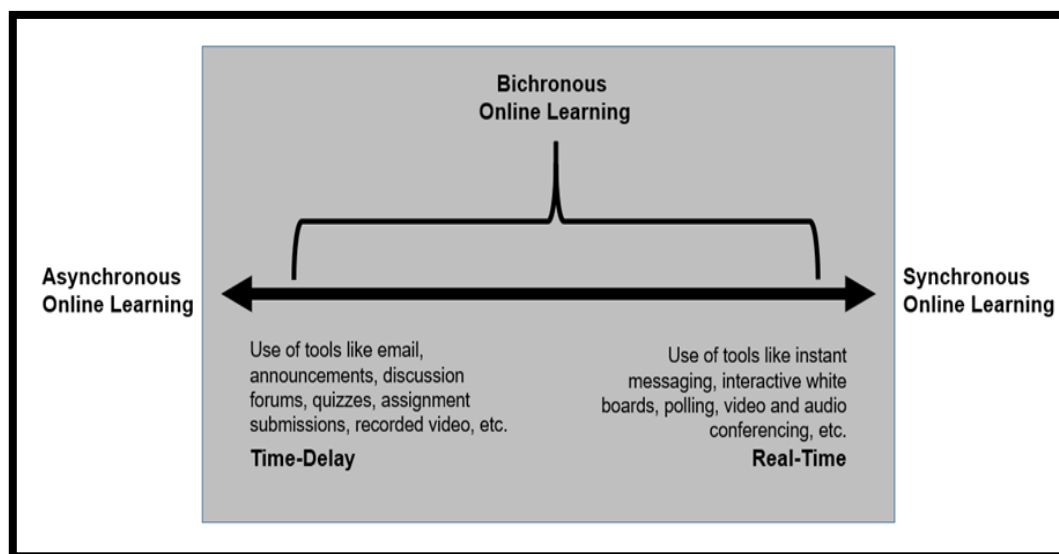


Figure 1. Bichronous online learning (Martin et al., 2020, p.1)

To support this transition, HEIs adopted technology-enhanced flexible learning, which emphasizes adaptability in terms of time, place, pace, and learning processes (Joaquin et al., 2020). In response, the Commission on Higher Education (CHED) issued guidelines to institutionalize flexible learning across Philippine HEIs (CHED, 2020). This approach utilizes a range of tools and platforms, including learning management systems such as Moodle, Canvas, and Blackboard, as well as offline and alternative delivery mechanisms. Several schools have implemented their learning management system to support both synchronous and asynchronous learning activities. While such systems enabled continuity, they also required significant adjustments in course design, assessment strategies, and instructional delivery. Educators were challenged to redesign learning experiences that are not only accessible but also cognitively meaningful in a digital environment.

A key concern in this transition is the extent to which online learning environments promote higher-order thinking skills. The integration of technology in teaching should not merely replicate traditional practices but should enhance cognitive engagement. Bloom's Revised Taxonomy, particularly in its digital form, provides a framework for aligning learning activities with varying levels of cognitive complexity. Rather than focusing solely on the use of digital tools, the emphasis is on how

these tools facilitate deeper levels of thinking, such as analyzing, evaluating, and creating (Sneed, 2016).

Designing assessments that promote higher-order thinking is especially critical in online learning environments, where access to information is readily available. For example, instead of tasks that require recall, educators may design activities such as peer reviews, digital storytelling, or problem-based projects that require students to analyze information, evaluate alternatives, and create original outputs. These approaches align with the higher levels of Bloom's Taxonomy and contribute to more meaningful learning experiences.

Despite these opportunities, several challenges have been reported in the implementation of online learning in the Philippines. These include unstable internet connectivity, limited access to devices and learning resources, power interruptions, unclear instructional materials, excessive workload, limited teacher support, communication barriers, competing home responsibilities, and concerns related to physical and mental health (Rotas & Cahapay, 2020). These constraints may influence how effectively higher-order thinking skills are integrated into teaching and learning practices.

Given this context, there is a need to empirically examine how thinking skills are manifested in technology-enhanced flexible learning environments. This study aims to assess the levels of thinking skills employed by educators during the pandemic using Bloom's Taxonomy as an analytical framework. Specifically, it investigates the extent to which different levels of cognition are integrated into instructional practices. The study seeks to provide empirical evidence on the effectiveness of flexible learning in promoting meaningful learning experiences and the development of higher-order thinking skills in Philippine higher education.

### Methods

The data for this study were derived from an open online course titled "*Portable Learning Management System: A Platform for Technology-Enhanced Flexible Learning in Schools with Challenging Internet Connectivity*" (Marcial, 2021). The course was conducted over three months and consisted of eleven modules designed to develop teachers' competencies in technology-enhanced flexible learning. The training incorporated bi-chronous, flipped, and microlearning approaches and was delivered through a learning management system using both synchronous and asynchronous modalities. A total of 118 teachers from private higher education institutions (HEIs) in the Philippines completed the relevant module.

Data were collected from one of the course modules, *Teaching and Learning Framework in Technology-Enhanced Flexible Learning*. In this module, participant-teachers were required to complete a reflective activity. They were asked to select a course they were currently teaching and identify a corresponding class activity implemented in an online learning environment.

Participants analyzed their selected activity using the SAMR model (Substitution, Augmentation, Modification, Redefinition) by identifying the level of technology integration and providing a brief justification. In addition, they aligned their learning objectives with Bloom's Digital Taxonomy by identifying the corresponding level of thinking skills and specifying the digital tools used in the activity.

The responses of the participant-teachers were analyzed to determine the levels of thinking skills reflected in their instructional practices. Each activity was categorized according to the levels of Bloom's Taxonomy (Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). Descriptive statistics, including frequency and percentage distribution, were used to identify the most and least utilized levels of thinking skills. A total of 100 valid responses were included in the analysis.

To examine relationships between participants' profiles and their taxonomy levels, inferential statistical analyses, including chi-square tests, were conducted. Additionally, regression analysis was performed to determine whether competencies in technology-enhanced flexible learning predicted the level of thinking skills demonstrated in instructional design.

### Results

Table 1 presents the distribution and ranking of thinking skills based on Bloom's Taxonomy as utilized in the *Teaching and Learning Framework in the Technology-Enhanced Flexible Learning* module. The results show that Creating was the most frequently utilized level (71; 59%), followed by Applying (24; 20%) and Analyzing (15; 13%). In contrast, Remembering and Understanding were the least implemented levels, each accounting for only 1% of the responses. The results suggest that technology-enhanced flexible learning during the pandemic provided opportunities for educators to design instruction that promotes higher-order thinking skills. At the same time, the findings highlight the need for a balanced instructional approach that integrates both lower-order and higher-order cognitive processes to ensure comprehensive learning outcomes.

Specifically, the distribution indicates a strong emphasis on higher-order thinking skills, particularly those associated with knowledge production and creative output. The predominance of the *Creating* level suggests that educators designed learning activities that require learners to generate original work, such as digital projects, presentations, and collaborative outputs. This aligns with the nature of technology-enhanced

learning environments, which support active and student-centered approaches to learning (Martin, Polly, & Ritzhaupt, 2020). The findings also reflect a pedagogical shift during the pandemic toward performance-based and authentic assessment strategies. In online environments, recall-based tasks are less effective in measuring meaningful learning and are more susceptible to academic dishonesty. As a result, educators tend to design activities that require higher-order cognitive processes such as analysis, evaluation, and creation, which are emphasized in Bloom’s Revised Taxonomy (Anderson & Krathwohl, 2001). However, the minimal representation of *Remembering* and *Understanding* suggests that lower-order thinking skills were less emphasized in instructional design. While the focus on higher-order thinking is beneficial, foundational knowledge remains essential as it supports more complex cognitive processes. Learners must first acquire and understand basic concepts before they can effectively apply, analyze, or create new knowledge (Anderson & Krathwohl, 2001).

**Table 1: Learning Objectiveness Taxonomy**

Taxonomy	f (%)	Rank
Remembering	1 (1)	5.5
Understanding	1 (1)	5.5
Applying	24 (20)	2
Analyzing	15 (13)	3
Evaluating	7 (6)	4
Creating	71 (59)	1

Table 2 presents the results of the chi-square analysis examining the relationship between respondents’ demographic profiles and their level of thinking skills based on Bloom’s Taxonomy. The findings indicate that region was the only variable significantly associated with the level of taxonomy ( $\chi^2 = 80.08, p < .05$ ). All other variables—including sex, civil status, internet experience, school type, and social media use—did not show a statistically significant relationship. The results highlight the importance of addressing regional disparities in

technological access and institutional support to ensure equitable implementation of higher-order thinking skills across higher education institutions. Efforts to strengthen infrastructure, provide targeted faculty development, and support flexible learning initiatives may help mitigate these differences and promote more consistent instructional quality across regions.

The significance of the region suggests that contextual and environmental factors play a crucial role in shaping instructional practices. In the Philippine context, regional differences often reflect variations in access to technological infrastructure, institutional support, and availability of learning resources. These disparities may influence how educators design and implement learning activities, particularly those requiring higher-order thinking skills. This finding is consistent with studies highlighting that unequal access to digital resources and infrastructure can affect the quality and depth of learning experiences in flexible and online environments (Joaquin, Biana, & Dacela, 2020; Rotas & Cahapay, 2020).

On the other hand, the lack of significant relationships between taxonomy level and variables such as sex, civil status, and internet experience suggests that the integration of higher-order thinking skills is less dependent on individual demographic characteristics and more influenced by contextual and institutional conditions. This implies that regardless of personal background, educators may be equally capable of implementing higher-order thinking strategies when provided with appropriate support and resources.

Furthermore, the non-significance of internet experience is noteworthy. While access and familiarity with technology are often assumed to influence teaching practices, the results suggest that experience alone does not necessarily translate into the effective integration of higher-order thinking skills. This reinforces the idea that pedagogical competence, rather than mere technological exposure, is critical in designing meaningful learning experiences (Martin, Polly, & Ritzhaupt, 2020).

**Table 2: Test of Relationships Between Taxonomy Level and Profiles**

Variables	$\chi^2$ Value	p-value	df	Remarks
FB Account	0.545	0.99	5	Not Significant
Twitter Account	4.335	0.50	5	Not Significant
Social Technologic Ladder	19.659	0.92	30	Not Significant
Internet Experience	13.624	0.55	15	Not Significant
Sex	3.701	0.59	5	Not Significant
Civil Status	6.135	0.80	10	Not Significant
Highest Educational Attainment	17.282	0.07	10	Not Significant
School Type	5.454	0.36	5	Not Significant
Region	80.082	0.04	60	Significant

Table 3 presents the results of the chi-square analysis examining the relationship between respondents' competencies in technology-enhanced flexible learning and their level of thinking skills based on Bloom's Taxonomy. The findings indicate that several competencies were significantly associated with taxonomy level, namely educational philosophy ( $\chi^2 = 34.79$ ,  $p < .05$ ), curricular transitioning ( $\chi^2 = 33.09$ ,  $p < .05$ ), instructional design ( $\chi^2 = 31.88$ ,  $p < .05$ ), assessment ( $\chi^2 = 31.59$ ,  $p < .05$ ), student interaction management ( $\chi^2 = 34.08$ ,  $p < .05$ ), and data privacy ( $\chi^2 = 41.03$ ,  $p < .01$ ). Other competencies, including leadership, tools and platforms, and resource management, were not found to be statistically significant. Generally, the results emphasize that pedagogical and design-related competencies, rather than technological factors alone, are critical in fostering higher-order thinking skills in technology-enhanced flexible learning environments.

The significance of instructional design and assessment highlights the central role of pedagogical competence in promoting higher-order thinking skills. Educators who are skilled in designing learning activities and assessments are more likely to develop tasks that require analysis, evaluation, and creation rather than simple recall. This aligns with the principles of flexible and online learning, where meaningful engagement is achieved through well-structured learning

experiences rather than the mere use of technology (UNESCO Institute for Lifelong Learning & Shanghai Open University, 2019; Howson & Kingsbury, 2021).

Similarly, the significance of curricular transitioning suggests that the ability to adapt course content and structure to flexible learning environments is critical in facilitating higher levels of cognition. During the pandemic, educators were required to redesign curricula to suit online and blended modalities, and those who were more effective in this transition were better able to integrate higher-order thinking skills into their instruction (Joaquin, Biana, & Dacela, 2020).

The findings also show that educational philosophy is significantly related to taxonomy level, indicating that teachers' beliefs about teaching and learning influence how they design instructional activities. Educators who adopt learner-centered approaches are more likely to implement strategies that promote critical thinking and knowledge construction, which are essential components of higher-order thinking (Howson & Kingsbury, 2021).

In addition, the significance of student interaction management underscores the importance of facilitating meaningful engagement in online environments. Effective interaction strategies support deeper learning and encourage students to engage in analytical and evaluative thinking processes, particularly in digitally mediated learning contexts (Rotas & Cahapay, 2020).

**Table 3: Test of Relationships Between Taxonomy and Competency in Technology-Enhanced Flexible Learning**

Variables	$\chi^2$ Value	$p$ -value	df	Remarks
Educational Philosophy	34.787	0.02126849	20	Significant
Leadership	26.673	0.14471709	20	Not Significant
Synergy of Technology and Learning Theories	27.51	0.12151555	20	Not Significant
Teaching and Learning Framework	28.069	0.10777603	20	Not Significant
Curricular Transitioning	33.086	0.03301471	20	Significant
Tools and Platforms	30.605	0.06062578	20	Not Significant
Instructional Design	31.884	0.04455015	20	Significant
Resources Management	29.362	0.08087228	20	Not Significant
Assessment	31.592	0.04784454	20	Significant
Student Interaction Management	34.075	0.0256218	20	Significant
Data Privacy	41.031	0.00369124	20	Significant

Further, a multiple regression was calculated to predict the level of taxonomy on all profiles of the respondents (see Table 3). The result shows that no significant regression equation was found between profiles of the respondents and the taxonomy level. Another multiple regression was calculated to predict the level of taxonomy of all competencies in technology-enhanced flexible learning of the respondents. A significant regression equation was found ( $F(11, 106) = 2.175, p < .000$ , with an  $R^2$  of 0.184). *Leadership* and *Assessment* were significant predictors of the level of taxonomy in the academic sector.

Table 5 presents the results of the ANOVA analysis conducted to determine whether significant differences exist in the level of thinking skills (Bloom's Taxonomy) across respondents' socio-demographic profiles and competencies in technology-enhanced flexible learning. The results indicate that most variables showed statistically significant differences ( $p < .05$ ), including FB account, Twitter account, internet experience, sex, civil status, highest educational attainment, school type, region, and all competency-related variables. In contrast, the social technologic ladder did not show a significant difference ( $F = 0.26, p > .05$ ). Results suggest that while demographic and

contextual factors contribute to differences in taxonomy levels, pedagogical competence remains the key determinant in promoting higher-order thinking skills. The non-significance of the social technologic ladder further underscores that technology alone does not determine learning quality; rather, it is the intentional and effective integration of technology into teaching that enhances cognitive engagement.

The non-significant result for the social technologic ladder suggests that differences in respondents' level of technological familiarity do not necessarily translate into differences in their level of thinking skills. This implies that access to or exposure to technology alone is insufficient to influence the cognitive level of instructional practices. This finding is consistent with studies emphasizing that the effectiveness of online learning depends not merely on access to technology but on how it is pedagogically utilized (Rotas & Cahapay, 2020).

On the other hand, the significant differences observed across most socio-demographic variables indicate that contextual and individual factors may influence how educators design and implement learning activities. For instance, variations in educational attainment, institutional context, and regional location may affect teachers' capacity to

integrate higher-order thinking skills, particularly in flexible learning environments where disparities in access, training, and institutional support are evident (Joaquin, Biana, & Dacela, 2020).

Furthermore, the consistent significance of all competency-related variables reinforces the earlier findings that pedagogical competencies play a critical role in shaping instructional practices. In

flexible and online learning environments, competencies such as instructional design, assessment, and student interaction management are essential in facilitating meaningful learning experiences and promoting higher-order thinking skills (Lim et al., 2022).

**Table 5: Test of Differences between Profiles and Competency & Taxonomy**

Socio-demographic profile	F	p-value	Remarks
FB Account	617.475	0.000	Significant
Twitter Account	1017.104	0.000	Significant
Social Technologic Ladder	0.259	0.611	Not Significant
Internet Experience	91.157	0.000	Significant
Sex	638.276	0.000	Significant
Civil Status	687.191	0.000	Significant
Highest Educational Attainment	456.816	0.000	Significant
School Type	764.446	0.000	Significant
Region	52.355	0.000	Significant
Educational Philosophy	171.828	0.000	Significant
Leadership	187.450	0.000	Significant
Synergy of Technology and Learning Theories	202.678	0.000	Significant
Teaching and Learning Framework	177.212	0.000	Significant
Curricular Transitioning	175.631	0.000	Significant
Tools and Platforms	157.462	0.000	Significant
Instructional Design	181.289	0.000	Significant
Resources Management	192.224	0.000	Significant
Assessment	176.532	0.000	Significant
Student Interaction Management	159.279	0.000	Significant
Data Privacy	190.459	0.000	Significant

### Conclusion And Recommendations

The COVID-19 pandemic brought significant changes to the global educational landscape, requiring higher education institutions (HEIs) to shift from traditional face-to-face instruction to online learning. In the Philippines, this transition presented challenges in maintaining educational

continuity while ensuring the safety of all stakeholders. As a response, various online learning modalities—such as asynchronous, synchronous, and bi-chronous approaches—were adopted within the higher education system.

The findings of this study revealed that during the pandemic, the most frequently utilized level of Bloom's Taxonomy was *Creating*, while *Remembering* and *Understanding* were the least implemented. The results also showed that regional location was significantly related to the level of taxonomy implementation. Overall, the study highlights the strong presence of higher-order thinking skills, particularly at the *Creating* level, in technology-enhanced flexible learning environments. It further demonstrates that both regional context and competencies in flexible learning influence how educators integrate higher-order thinking skills into their instructional practices.

Despite these developments, several challenges were encountered during this period, including unstable internet connectivity, limited learning resources, power interruptions, unclear instructional content, excessive workload, limited teacher support, communication difficulties, competing home responsibilities, and concerns related to physical and mental health. Nevertheless, educators and students demonstrated resilience and adaptability in sustaining meaningful learning experiences.

Thus, the COVID-19 pandemic highlighted the importance of adaptability, creativity, and resilience in higher education. As HEIs in the Philippines and beyond continue to evolve, prioritizing the integration of higher-order thinking skills and effectively leveraging technology-enhanced flexible learning can help ensure meaningful and effective educational experiences, even in challenging contexts.

As higher education continues to navigate the "new normal," it is essential for Philippine HEIs to strengthen the promotion of creative and critical thinking skills in online learning environments. The findings emphasize the need to address regional disparities and to enhance competencies in technology-enhanced flexible learning to support the effective integration of higher-order thinking skills.

Specifically, the following are recommended:

1. Provide comprehensive training for educators in technology-enhanced flexible learning, with a focus

on strategies that promote higher-order thinking skills in online instruction (UNESCO). Institutions should also establish support systems to assist educators in adapting to digital platforms.

2. Review and enhance curricula to prioritize the development of higher-order thinking skills (Howson & Kingsbury, 2021). This includes designing learning activities and assessments that foster critical thinking, problem-solving, and creativity.
3. Ensure equitable access to technology and learning resources among students (Jemeli & Fakandu, 2019). Providing devices, reliable internet connectivity, and relevant materials can help address the digital divide.
4. Promote continuous professional development for educators in instructional design, assessment strategies, and technology integration (Kalinowski, Gronostaj, & Vock, 2019), which can contribute to improved teaching quality and student engagement.

The need for a comprehensive and coordinated approach to strengthening technology-enhanced flexible learning in higher education is a must. Schools must invest in faculty development, curriculum enhancement, equitable resource distribution, and continuous professional learning. In this way, HEIs can better support the integration of higher-order thinking skills in online environments. Such efforts will not only address current challenges but also contribute to the long-term improvement of teaching and learning practices, ensuring that education remains relevant, inclusive, and responsive in an increasingly digital landscape.

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